THE KENT INCORPORATED SOCIETY
FOR PROMOTING EXPERIMENTS IN
HORTICULTURE

ANNUAL REPORT

(FIFTEENTH YEAR)

1927

I. GENERAL

EAST MALLING RESEARCH STATION

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CONTENTS

SECTION I.

PAGE

GENERAL DEVELOPMENT AND ACTIVITIES 9

SECTION II.

THE FARM 29

SECTION III.

BRIEF PROGRESS REPORT OF INVESTIGATIONS AND SUMMARIES FOR FRUIT GROWERS 33

Part I. POMOLOGY.

Progress Reports 37
Publications During the Year 41
Summary for Fruit Growers :—
"'Reversion' in Black Currants. Its Causes and Eradication."
J. AMOS, R. G. HATTON, R. C. KNIGHT and A. M. MASSEE 43

Part II. PHYSIOLOGY.

Progress Report 49
Publications During the Year 50

Part III. PLANT PATHOLOGY.

Progress Reports 53
Publications During the Year 56
Summary for Fruit Growers :—
"Raspberry Cane Spot and its Control." R. V. HARRIS 57

PAGE

Part IV. ENTOMOLOGY.

Progress Report 67
Publications During the Year 69

Summary for Fruit Growers :—
" Winter Washes : Modern Developments In Their Use."
A. M. MASSEE 70

Part V. HOPS.

Progress Report 81
Publication During the Year 82

Part VI. WEATHER CONDITIONS DURING 1927 83

RULES OF MEMBERSHIP AND LIST OF ASSOCIATE MEMBERS 89

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R. V. HARRIS, B.Sc. (Lond.), A.R.C.Sc., D.I.C.
M. H. MOORE (Dip. Hort. Sci., Reading), (Special Assistant).

Entomology: A. M. MASSEE, F.E.S.

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Statistics: T. N. HOBLYN, (Hort. Dip., Wye).

Guide Demonstrator and Exhibitions Officer: H. C. CHAPELOW (Meteorological Records).

Laboratory Assistants: C. CORNFORD, Miss I. D. SKINNER, Miss K. CORNFORD.

Horticultural Advisory Officer to Kent County Council stationed at East Malling: N. B. BAGENAL, B.A. (Cantab.).

Secretary: Miss M. K. GLOVER, F.I.S.A.

Book-keeper: P. R. WOOD.

Shorthand Typists: Miss M. B. HOAD, Miss E. M. SHEPHERD, Miss E. D. SIMONS, MISS E. M. LAWSON.

Visiting Days: Tuesdays and Fridays, or by special appointment.
Hours: 10-12 a.m. 1-5 p.m.

Passenger Station: East Malling Halt. *Goods:* Aylesford.

Bus Services from Maidstone every twenty minutes to East Malling Church.

Ditton Corner, on the main London to Maidstone Road, is the turning to the Research Station for visitors coming by road.

SECTION I

GENERAL DEVELOPMENT AND ACTIVITIES.

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Section I

GENERAL DEVELOPMENT AND ACTIVITIES.

The year 1927 saw the fulfilment of some of those developments foreshadowed in our last report, and the Station experienced some of the natural consequences therefrom.

The most noteworthy fact has undoubtedly been the intensification of our activities, made possible by the Empire Marketing Board's encouragement. The attention of that body was first drawn to the significance of our investigations by the Central Council of the National Farmers' Union, to whom our thanks are therefore also due, for thus enabling us to take this step forward in the certainty of retaining the confidence of the Industry.

The Board's generous assistance, given on wide terms of reference, has enabled us to develop much more rapidly our main lines of research by filling up those gaps in the ranks of our investigators, additions so necessary to complete the team, but previously so far beyond our reach.

Partly as a result of these developments, and partly in consequence of the normal growth of demands from without, nearly every section again bears witness to an increase of our activities. In some directions, the increase has been phenomenal—as in the case of the sixty per cent. rise in the number of our visitors and bulk of our post bag—a level which it is anticipated can hardly be maintained.

At the same time, there are signs that the Station may have further responsibilities to face in the near future. If, for instance, the recommendation of the Imperial Agricultural Research Conference with regard to the establishment of a Correspondence Centre in Fruit Production at East Malling should be pressed, and if the demands for facilities for post-graduate work become more insistent, further development of both staff and accommodation will be essential.

Again, in the near future we hope to welcome as neighbours the Staff engaged in a development of the Cambridge Low Temperature Station, under the auspices of the Food Investigation Board. This is a development, in some aspects of which, our participation is confidently expected.

If, in aiming at becoming more adequately equipped as a reliable source of information, our activities should widen along such channels, it will not be at the expense of long established contacts with the Industry at home, nor will the Station stand in any less need of its continued interest, confidence, and support. Indeed, if facilities are forthcoming, we shall endeavour to strengthen these

mutual ties still further by arranging for a more frequent exchange of ideas and the wider dissemination of information.

Committees.

It has been a matter of universal regret that the serious illness of the Chairman, Mr. Percy Manwaring, prevented his participation not only in the notable gatherings during the year, which bore witness to the efficacy of his hard work on the Station's behalf in the past, but also in the Committee's deliberations, where his good counsel has always been so timely. His speedy restoration to health and to the Committee has been the frequently recorded wish of all his colleagues.

Mr. William Rogers readily agreed to the Committee's request that he should act as Chairman during Mr. Manwaring's absence, and he has most willingly helped the Station through a strenuous year.

The Station has lost a zealous advocate of its work by the death of Mr. W. Troy, the representative of the East Sussex County Council on the Committee of Management. His visits, with the Horticultural Sub-Committee of the County, to keep in touch with our developments, had become an annual event which was looked forward to, and would be welcomed as a precedent, if followed by other counties. His successor, Mr. E. S. Attrell, has long been in touch with the Station.

Mr. T. T. Harlow has once again assisted on several of the Sub-Committees.

During the year the Executive Committee met three times, whilst Sub-Committees, dealing with Buildings, Land Purchase, and Staff Appointments, met on five occasions. Amongst the chief subjects dealt with by the Committees, besides general finance, were the scheme of extension under the Empire Marketing Board Grant, which involved the erection of additional buildings and the acquisition of fresh land, the increase of staff, the equipment of the new buildings, the proposal for initiating an endowment scheme, and the arrangements for the visits of the National Farmers Union during their tour of fruit plantations and of the Imperial Agricultural Research Conference.

The Annual General Meeting.

The Seventh Ordinary General Meeting of the Society was held on June 3rd, 1927, when the Annual Report and Balance Sheet were presented and approved.

Since this was the first meeting after the inauguration of the Associate Membership Scheme, which gave to all Associates the right to be summoned to attend the meeting, it was rather disappointing to have only a small attendance. This was doubtless due in part to the fact that the N.F.U. Tour just preceded the meeting.

Though the meeting was not large, those of the Station's supporters who came, showed by discussion and suggestion how valuable such gatherings might be. A tour of inspection of the Laboratories and Experimental plots aroused plenty of interest.

It is hoped in future to make the Annual General Meeting an important event in the Station's year.

Finance.

The Maintenance Grants for the Academic Year (1st October, 1926, to 30th September, 1927), received from the Ministry of Agriculture totalled approximately £7,500.

In addition, Special Research Grants were received to enable us to continue the Special Investigations into Raspberry Diseases, and the Incidence and Control of Apple Scab.

On 1st October, 1927, the Empire Marketing Board Scheme involving an additional Maintenance Grant, totalling in the first year £5,068, came into operation, contemporaneously with the increase in staff.

The County Councils of Kent, East and West Sussex continued their welcome annual contributions, but there are still several other counties receiving considerable benefits in the way of advice by letter and visit which have not followed the good example.

Despite a very adverse season both in respect to fruit crops and prices, the actual sales of produce amounted to £3,078, as against £3,031 in the previous year. However, this figure is very much below what might have been anticipated under normal conditions, and the Farm Account shows a considerable overdraft.

Buildings.

The new Laboratories and Administrative quarters were not actually occupied before the middle of October. This was largely due to the necessity under the Empire Marketing Board Scheme of adding to the structure a further Laboratory, together with storage accommodation. These new Buildings, which now comprise, on the upper floor Pathological, Entomological and Biochemical Laboratories, together with their complement of Preparation, Culture, Breeding and Spraying Rooms, with the main Administrative Offices on the Ground Floor, were fully occupied immediately they became available.

The Architects, Messrs. Forsyth and Maule, are to be congratulated on having provided a thoroughly serviceable and comfortable building, with the limited funds available, and, at the same time (as the frontispiece shows), on having used the local brick and tile to pleasant effect in keeping with the rural surroundings.

Messrs. Davison and Son, the local builders, once again did good work and are specially to be congratulated on their efficiency in meeting our somewhat exacting requirements in the way of special laboratory fittings.

A very serviceable brick and tile packing shed, with small offices for the Propagator and Marketing Officer, which will be used for the work of distribution of experimental material during the winter and for the packing and grading of fruit during summer and autumn, was erected during the year with the assistance of the Empire Marketing Board Grant.

For the purpose of extending the space available for pathological investigations into disease resistance, etc., under controlled conditions, a new Laboratory-Greenhouse, with separate compartments for propagation, inoculation, and preparation operations, was erected under the same scheme. The building is a very efficient addition to the Station's equipment; in all approximately 95 feet long, it was erected in teak with specially constructed insect-proof ventilation, etc. Messrs. MacKenzie and Moncur, who designed the building to meet the Pathologists' requirements, and erected it, deserve thanks for the great care and interest which they showed throughout in this very specialised piece of work.

As a result of these additions, it has been possible to restore the staff cottage —used as the administrative quarters since 1924—to its proper use as a dwelling house. At last a resident caretaker is in occupation.

On the other hand, it has not been possible to hand over to the farm, as was anticipated, the original bungalow building to provide the much needed storage accommodation. This building, which has served so many purposes, has had to be re-fitted for the Statistical Section and to afford accommodation for the Recording Staff.

Finally, the ever-increasing number of large parties, which the Station, owing to its position of isolation, is called upon to accommodate and cater for, continue to be dealt with under great difficulties. The need for adequate Conference quarters is more emphatic than ever.

Land.

Out of the Empire Marketing Board Grant, an additional twenty-five acres of land, Newgates Field, in close proximity to the rest of the station, has been acquired from Mr. Osborne Dan. This area will in the main serve as the Nursery for raising our selected root-stock material more rapidly than has hitherto been possible.

This addition brings the total area of the Station's experimental land to approximately 108 acres, practically all of which is suitable for the development of fruit investigations.

STAFF.

Once again the Station is in the happy position of being able to chronicle the fact that the only changes in its permanent staff have been in the nature of additions. Moreover, it has been fortunate in being able to fill several of its new posts with workers already fully conversant with the Station's outlook.

On the other hand, the year has been notable for the amount of illness experienced among the staff, who, however, must be congratulated upon the apparently small effect which it has had upon output of work.

For some time past, the development of the Station has indicated the necessity of giving some assistance in its direction. It was therefore made possible, with the full approval of Professor V. H. Blackman, of the Imperial College, to appoint Dr. R. C. Knight, D.Sc.(Lond)., D.I.C., of the Imperial College of Science and Technology, Assistant Director at East Malling. It is hoped that this will not in any way interfere with his Physiological Investigations, especially as he will have the full time collaboration of an Assistant Physiologist. This latter post was filled by Mr. M. C. Vyvyan, M.A. (Cantab.), formerly of the Cambridge Horticultural Research Station. In addition, Mr. W. A. Roach, A.R.C.Sc., B.Sc., D.I.C., has joined the Staff (from Rothamsted) to develop the Bio-Chemical aspects of our researches.

The Pomological Section has been strengthened by the advent of Mr. W. S. Rogers, B.A. (Hort. Dip., Cantab.), who during his diploma work had already been associated with the Station. Mr. T. N. Hoblyn (Hort. Dip., Wye) has returned to take up permanent work on the Statistical side, whilst Mr. A. C. Painter has taken up the position of Assessor of Market Qualities.

The Pathological Section was able to secure the services of Mr. R. V. Harris, B.Sc., A.R.C.Sc., as Assistant Pathologist, when his special research grant work terminated. The renewal, by the Ministry of Agriculture, of the special research grant for the investigation on the Incidence and Control of Apple Scab has enabled Mr. M. H. Moore (Dip. Hort. Sci., Reading) to continue his work.

Mr. W. Steer (B.A., Cantab.) continued to give assistance in the Entomological Section during his vacations, and, under the conditions laid down for the extension of his Ministry of Agriculture Scholarship, he is now working part time at East Malling and part time at the Imperial College of Science, and is giving special attention to the Insect Pests of Raspberries.

Temporary assistance was rendered by Mr. R. Moseley (Hort. Dip., Wye), who wished to renew his connection with the investigational side of fruit culture, Mr. Lindsay J. D. Mackie, who came to us during his vacations from Cambridge, and Miss Nash, B.Sc. (Horticulture), who helped with the recording work generally for a few weeks during the busiest season.

The Social and Athletic Club.

During the year, the activities of the Club have been much the same as in 1926. The membership also remains about the same, the books showing a total of eighty-two at the end of the year.

On the social side, the functions organised included a winter theatre outing to London, a summer outing to Margate, and a Christmas supper and concert. For the latter, the Club made good use of the better accommodation provided by the new Packing Shed. All these functions were well supported.

In November a literary circle was formed in connection with the Club. The three meetings held during the remainder of the year were very well attended.

The Cricket Section still feels the handicap of not possessing a pitch of its own, but, owing to the kindness of the East Malling Cricket Club, practice facilities were available on the East Malling ground throughout the season. Altogether eight matches were played against local teams, two of which were won, one drawn, and five lost.

The Tennis Section is more fortunate with regard to accommodation, and, in spite of the poor weather during the summer, good use was made of the hard court.

Staff Meetings.

Eight meetings were held during the year, with an average attendance of nineteen.

Professor W. Brown, of Imperial College, gave an account of his work on the deterioration, as a result of disease, of Scotch seed potatoes.

Mr. R. H. Le Pelley, of Cambridge, described his experiments on Woolly Aphis, which had been carried out at the Station.

As the Station increases the scope of its work and the number of its staff, it is becoming increasingly difficult to deal with a year's work in a series of eight meetings, and some amplification of the system is indicated.

Collaboration.

Owing to the number of new staff appointments, both at Long Ashton and East Malling, the joint annual meeting, for the discussion of programmes of work, has been postponed until well into the New Year. There have, on the other hand, been several interchanges of visits between individual members of the two staffs to discuss problems of mutual interest.

Dr. R. C. Knight is now actually assisting in the administration of the Station as well as collaborating in investigations of our physiological problems, our best thanks are once more due to Professor V. H. Blackman and the Research

Institute of Plant Physiology, Imperial College of Science for making this very effective and close collaboration possible. The hope expressed last year, that we might be able closely to associate with Dr. Knight a bio-chemist and assistant physiologist, has been realised.

Three members of the Staff of the S.E.A. College, Wye, have been actively interested in the Hop Investigations at East Malling, thus continuing the unbroken connection since their inception. Professor E. S. Salmon, F.L.S., sent us during the year further batches of his New Seedling Hops for commercial trial, and he has once again issued a report based on the joint records taken on the behaviour of his older selections at East Malling. We were also glad to see Mr. W. M. Ware, M.Sc., in our hop gardens continuing the " mosaic " investigations by grafting methods. Mr. A. H. Burgess, B.Sc., has continued to give us advice upon the chemical aspect of our Hop Manurial Trials. To them and to Mr. F. C. Arnaud, F.I.C. (County Analyst), who once again consented to analyse the manures, our best thanks are due.

Dr. W. Goodwin, of the Chemical Department, S.E.A. College, Wye, has continued to collaborate with our Entomological Section in testing the egg-killing properties of certain preparations.

Mr. M. B. Crane, of the John Innes Horticultural Institution, Merton, has continued the work of crossing Northern Spy Stock (immune to Woolly Aphis) with Malling root-stocks Nos. IX, II, I, and XII.

Mr. F. T. Brooks, M.A., of the School of Botany, Cambridge, has maintained his interest in our field trials designed to combat Silver Leaf Infection.

Proposed Joint Fruit Soil Survey in Kent.

With the approval of the Ministry of Agriculture's Fruit Soil Survey Sub-Committee, the S.E.A. College, Wye agreed, in collaboration with East Malling, to initiate a fruit soil survey, starting with the Greensand formation in Kent, provided special funds were made available. Whilst Dr. Goodwin, of Wye College, with the assistance of a soil chemist, was to deal primarily with the soil chemistry and physics, East Malling, with the aid of a pomologist, was to watch the problems of fruit growing involved. It was hoped also to utilise Mr. N. B. Bagenal's intimate knowledge of the County. Although the special grant has as yet not materialised, a four-days' tour of the Lower Greensand area was made under Mr. Bagenal's guidance by Dr. Goodwin and members of the East Malling Staff. Similar short tours were made in Hereford and in the Eastern Counties, where surveys were already nearing completion.

East Malling decided this winter to get some preliminary idea of the root development of apple trees on the Greensand formation by lifting and examining, in detail, a series of ten year old trees on known root-stocks, and Dr. Goodwin has agreed to make analyses (mechanical and chemical) of the soil at various

depths. Thus, when the money is forthcoming, it is anticipated that a very valuable foundation for the Survey will have been laid.

The Journal of Pomology and Horticultural Science.

The Journal of Pomology and Horticultural Science has again been edited from East Malling. This editorial work has also involved the preparation of a prospectus, bringing the Journal to the notice of a wider public, and the preparation of the annual Index. A number of problems in connection with the Journal have been dealt with.

The Station's Publications.

The production of the Station's own Supplement II. for 1926 had, in consequence of the heavy work entailed in editing the above Journal, to be abandoned for the year, but it is hoped shortly to publish a single supplement dealing with the detailed progress reports of research work for 1926 and 1927 together.

As detailed later, in all some thirty complete reports of investigations were published in various scientific and technical Journals during the year. Nine dealt with Pomological subjects, one with Hops, four with Physiological aspects of the work, nine with Mycological and Bacterial investigations and seven with Entomological problems, though in many cases the various sections wrote joint papers, thus bearing striking witness to the very close collaboration among the whole staff.

Outside Trials.

The ever increasing accumulation of results on the Research Station have made it inevitable that less time should be spent on the root-stock trials planted in other areas, though at least one visit during the season to most of the plots has been possible. The pruning and crop recording has been undertaken once more on the most complete of our Apple Stock Trial plots, namely at the Swanley Horticultural College, Kent, and on Mr. A. J. Carter's farm at Wisboro' Green, West Sussex. Our thanks are due both to the Principal of Swanley and to Mr. Carter for their continued forebearance and consideration. Mr. A. N. Rawes, of the Royal Horticultural Society, has very kindly continued to take records on our trees at the Wisley Gardens, and Mr. N. B. Bagenal has kept an eye on the plot at Tunstall. We wish to thank both these gentlemen. Altogether, the equivalent of some twenty-six full days' work of a single recorder was spent by members of staff in making observations upon these plots.

The pruning experiments at Parsonage Farm, Brenchley, were continued for another year.

The Pathological section carried out a spraying trial against Brown Rot

on Acid Cherries in a neighbouring orchard, and conducted an experiment on the Control of Hop Wilt, by soil treatment, at Penshurst.

Our thanks are due to the growers who have given us facilities for carrying out such field work.

ADVISORY WORK.

(*a*) *Correspondence.*

The number of answers to queries by letter again shows a considerable increase (61) over the previous year. A large proportion of the increase has fallen upon a single research worker in the Entomological Section, whilst one member of the Pomological Staff is responsible for dictating some 562 replies to enquiries. Thus, on certain members of the research staff, this work becomes more exacting each year, and must inevitably absorb time from investigational. work. At the same time, it is an inevitable development of any Research Station's activities, for which special provision should be made.

As in former years, the analysis of the subjects dealt with, which is given below, shows that the great majority of enquiries referred very directly to subjects under special investigation at the Research Station.

In addition to the 1,028 replies written by the Research Staff, some thirty-one queries on general subjects from Kent growers were referred to Mr. Bagenal to be dealt with.

Pomology.		
Small Fruits (mainly Black Currants and Raspberries) ..	160	
Fruit Tree Root Stocks	171	
Propagation	71	
Planning and Planting (in relation to suitability of Stock, Soil, Variety, etc.)	32	
General Spraying	44	
Pruning	28	
Manuring	16	
Miscellaneous	237	
	——	759
Pathology.		
Raspberry Diseases	24	
Dieback (Bacterial Canker and Shot-hole)	9	
Apple and Pear Scab	6	
Brown Rot	6	
American Gooseberry Mildew	9	
Crown Gall	3	
Hop Diseases	7	
Miscellaneous	50	
	——	114

Entomology.

Gall Mites	33	
Red Spiders	13	
Coleoptera (mainly Weevils)	17	
Aphides	16	
Capsids	10	
Insecticides (Tar Oil and other Winter Washes)	16	
Fumigations	6	
Lepidoptera	14	
Sawfly	4	
Miscellaneous	26	
	—	155
Total		1,028

As usual, many of the enquiries have involved the examination and identification of specimens, etc., whilst others of our Associate members have been advised as to every detail in the planning and planting of considerable areas of fruit.

Approximately 350 of these enquiries came from Kent; Sussex was a good second with well over 100, a rather larger proportion coming from the Western half of the county. From Surrey, Hampshire, and Suffolk and Norfolk came over forty enquiries from each, whilst Essex, Middlesex, and Bucks., Berks. and Oxon, accounted for between twenty and thirty apiece.

Some thirty-seven enquiries, chiefly about our rootstock work and the laying out of experimental plots, came from the Dominions and Colonies, whilst twenty-five foreign enquirers also corresponded.

(*b*) *Telephone.*

It would appear that the use of the telephone as a medium of enquiry has increased even more rapidly than the post bag. Although it is difficult to keep an exact record, it is estimated that between 700 and 800 queries have thus been dealt with.

(*c*) *Visits.*

Individual members of the Research Staff report having paid 157 visits to Growers on their farms during the year. In addition, Mr. Bagenal made some 151 calls in Kent, many of which were the direct or indirect result of applications from growers to the Research Station.

Besides the short tours of the Fruit Soil Survey areas in Hereford in company with Mr. T. Wallace, of Long Ashton, and in Cambridge in company with Dr. Newman and Mr. C. Wright, and the similar expedition along the Kent Greensand ridge, several other organised visits were carried out.

In order to obtain information as to the distribution and purity of the chief commercial varieties of red currant, some twelve plantations were carefully examined in various parts of Kent. Again, the judging undertaken on behalf of the plantations competition brought members of our Staff in contact with growers.

On another occasion, a series of Strawberry plantations were visited with a view to ascertaining good sources for the supply of runners. In all these cases, special thanks are due to Mr. Bagenal for the expert guidance rendered in paying these visits.

Once again an effort was made to meet the demands of our members to have their black currant plantations and cutting beds "rogued" for reversion. It was found possible to deal with nine such applications, but many of the areas involved were so considerable that about eighteen days were given up to this work by a member of Staff. Subsequently, detailed reports of the condition of his beds were furnished to each grower. In several instances, the roguing of stock stool beds was also undertaken.

Lectures, Demonstrations and Conferences.

(*a*) *Lectures and Demonstrations.*

Members of the Research Staff were called upon to give sixteen Lectures. Whilst seven of these were to local societies in Kent, and two in Sussex, the other seven were more or less far afield, including Reading, Pershore, Chelmsford, Norwich and Cambridge.

Mr. Bagenal, the County Horticultural Adviser, gave lectures to four branches of the Kent N.F.U., on various practical aspects of the results obtained at East Malling.

After discussion with Mr Bagenal, it was decided to discontinue for the present the annual pruning demonstrations which have been given in various parts of the County, and it was agreed that the time had come for a more intensive campaign, altogether beyond the legitimate activities of the research worker. Mr. Bagenal, therefore, undertook to give four courses of six lectures, demonstrating the pruning methods recommended at East Malling, at various centres in Kent. An average attendance of fourteen (or a total of 336 attendances throughout) testifies to the popularity of this development, and it has brought the Station's findings right to the doors of the actual tree cutters.

Two grafting demonstrations were given during April at the Research Station, and on an adjacent commercial plantation. The first, organised by Mr. Bagenal, was attended by some twenty-five fruit growers and their fruitmen. The second, organised by Mr. W. P. Wright, was given to a large party of Kent School Teachers. Informal demonstrations on methods of grafting, budding,

layering, etc., have been given throughout the season to parties and individual enquirers as the occasion arose.

A demonstration of the capabilities of the various small motor cultivators, claiming to be suitable for plantation and nursery work, was held on April 21st, and attracted about 100 visitors. Mr. W. T. Edmonds kindly lent us one of his ponies, so expert at "shimming," so that our visitors could compare the work of the mechanical tools with that of the old method at its best on the spot.

The Entomology Section has been called upon to give five demonstrations in the proper methods to employ in fumigating Glass Houses.

(*b*) *Conferences, Committee Meetings, etc.*

At the request of Mr. Dallinger, of the Ministry of Agriculture, a three days' conference was arranged in connection with the Ministry's scheme of giving certificates for Black Currants true to name and free from Reversion and Big Bud. Various members of staff gave papers and opened discussions each morning, whilst the latter half of each day was spent in roguing operations upon plantations.

Mr. A. H. Lees, of Long Ashton, accepted the Station's invitation to assist during the Conference, and our thanks are due to him for materially adding to its success.

A number of the Ministry's Inspectorate were in attendance, and the Station's staff welcomed the opportunity, once again, of getting into intimate touch with members of that most understanding body.

Several of the other organised visits of parties partook of the nature of Conferences in that they necessitated the arrangement of definite exhibits in the laboratories, demonstrations in the plantations, and series of lecturettes by a considerable number of the research staff throughout the proceedings. Such especially were the visits of the Horticultural Education Association on September 1st, and of the Imperial Agricultural Research Conference on November 1st.

The Horticultural Education Association elected to spend one day of their annual outing at East Malling, and the suggestion was made that the question of Fruit Tree Pruning should be made the special subject of study. Those members of staff especially connected with these investigations opened the way to lively discussions by giving an outline of their experiments and findings to date.

The visits of members of the Imperial Agricultural Research Conference demanded still more organisation, since the aim was to give our overseas colleagues a bird's eye view of our programme of activities and of the close inter-relationship of one section with another, and of the whole with the growing plantations. In view of the date of the visit, every preparation had to be made for the contingency of wet weather, as well as for outdoor excursions under favourable conditions. Every section staged exhibits illustrative of its lines of investigation and methods

employed, and were kept busy throughout the day delivering lecturettes to relays of visitors. A similar method of organisation was adopted for the visit of the Annual Fruit Plantation Tour of the National Farmers' Union on June 2nd.

Very different interests were represented by the various parties of visitors thus entertained, and, consequently, a different aspect of the work had to be presented on every occasion. Thus, instead of organising and preparing a demonstration which shall serve for a number of visits, it is always necessary to plan each demonstration afresh with due regard to the interests of our guests. Probably only those on the spot can actually realise the demands on the material, time and energy of every section of the research staff, who responded with enthusiasm to those very different and interesting occasions.

As usual various members of staff represented the Station on numerous Committees and Sub-Committees, connected with various aspects of the Industry and Research. Amongst these may be mentioned the Agricultural Research Council, the Horticultural Advisory Council, the Horticultural Sub-Committee of the Meteorological Committee, the Fruit Soil Survey Sub-Committee, the Agenda and the Fruit Sub-Committees of the Imperial Agricultural Research Conference, the Virus Disease Sub-Committee, the Publication Committee of the Journal of Pomology and Horticultural Science, and the Food Canning Council.

Representation on many of these and other Committees involved the attendance on several occasions of more than one member of staff, whilst the Imperial Agricultural Research Council's deliberations lasted approximately for a fortnight and necessitated almost daily attendance in London.

Exhibits.

In view of the exceptionally heavy calls upon the time both of the research staff and the exhibits officer, which were foreseen in the programme of Conferences and visits which had been arranged, it was decided to curtail this side of our activities as far as possible, and to restrict our exhibits to the home counties.

Four such shows were attended. At the Sussex County Show, Chichester, an exhibit, chiefly illustrating the results of our researches with small fruits, was staged in July. Three members of staff attended during the two days, apart from the staging operations.

The Kent County Show (three days) at Sevenoaks immediately followed this. Some seven members of staff were in attendance at a mixed exhibit, including small and top fruits and their diseases.

For the first time the Station was invited to stage an exhibit at the Southern Counties Agricultural Society's Show at Tunbridge Wells. An extremely comprehensive exhibit was actually staged, but, to the disappointment of

everybody concerned, an unexpected outbreak of foot and mouth disease prevented the Show from opening.

The Station was also invited to stage an exhibit at the Ashford Fat Stock Show in December. Here the effect of potash manuring on apples was especially emphasised in a district where leaf scorch is known on occasion to be prevalent. Four members of staff were in attendance during the two days.

The completion of the small exhibits staging room in the new building has rendered possible considerable progress in the indexing and organising of the various exhibits, and has facilitated designing operations, but it is neither large enough nor was it intended for the purpose of staging permanent exhibits.

VISITORS.

The past year has established a record for the number of visitors who have come to the Research Station. Whilst it is true that there have been more organised parties—twenty-two as against nineteen in the previous year—and that several of these parties have been exceptionally large, the following table shows that the calls of individual enquirers have also been more widely distributed over the whole year than previously.

Recorded Visitors, 1927.

Month.	No. of days on which visits were paid.	No. of Visitors per month.
January	6	16
February	15	25
March	21	38
April	17	173
May	14	76
June	20	325
July	18	140
August	22	101
September	21	184
October	23	59
November	19	88
December	11	29
Total	207	1,254

In 1926 individual visits were paid on 161 days, in 1927 on 207 days. Nor do these figures convey the complete picture, for on many of these days, two or three separate visitors arrived at different times to be conducted round the

Station, and several members of Staff, besides the Guide, have been frequently occupied in this way.

The figure of 1,254 recorded visitors does not include the periodical visits of the East Malling school children, who have been accompanied this year by children from Mereworth school. At least 140 of these young and intelligent enquirers could be added to the signatures in the visitors' book, thus bringing the number to approximately **1,400**—a very big increase over the 1926 figure of 862.

The year was, of course, a notable one for the number of overseas visitors—quite apart from the very representative gathering of the Imperial Agricultural Research Conference led by Lord Bledisloe, we have had many individual overseas guests from various parts of Canada, Australia, New Zealand, Africa, India, Egypt, and Ceylon, including both those interested in research and also in the economic side of the industry. Many of these visits were most stimulating, and, amongst others, long will be remembered those of Mr. G. A. Julius, B.Sc., Chairman of the Commonwealth of Australia Council for Scientific and Industrial Research with Mr. F. L. McDougall, C.M.G., of Australia House, of Professors R. D. Watt (Sydney) and A. E. V. Richardson (the Waite Institution, Adelaide), and of Sir George Pearce, Commonwealth Minister of Scientific and Industrual Research. From New Zealand, we benefited from personal contact with Dr. C. J. Reakes and Mr. T. Rigg, M.A., of Cawthron ; and from Canada, with Mr. W. T. Macoun, Dominion Horticulturist, Mr. P. E. McIntosh, Fruit Commissioner, and Mr. Lionel Taylor, representing the growers of British Columbia.

Amongst our foreign visitors were citizens of Italy, Holland, Denmark, Germany, Poland, Hungary, Czechoslovakia, Japan, the Argentine, and many parts of the United States.

We welcomed the short visits of Dr. E. J. Kraus, Professor of Botany at Chicago, of Professor O. F. Curtis, of Cornell, and the comparatively long stay of Mr. R. Wellington, of Geneva, N.Y. We also had the opportunity of renewing contact with Drs. C. F. Swingle (Washington), K. Sax (Maine), and Leach (Minnesota) amongst others.

The visits of the Imperial Agricultural Research Conference, the Annual Fruit Tour of the National Farmers' Union, and the Horticultural Education Association, have been mentioned elsewhere. Amongst other occasions which will be remembered were the visit of the South African Farmers, and the Phytopathological foray of the British Mycological Society. Several branches of the National Farmers' Union, including the Goudhurst, Paddock Wood, and Rye branches, arranged an outing to the Station. An ever-increasing interest in the Station's work is also being taken by the general public and by amateur gardeners. Visits from the Rochester Naturalists, the Maidstone Allotment Holders and the Mereworth Gardeners' Societies are evidence of this. Such parties not infrequently

involve the giving up of the Saturday afternoon recreation by various members of staff, but the sacrifice has been made with a good will in the knowledge that it is the only possible day for some gardening societies.

As usual, parties of students from the Royal College of Science, Swanley Horticultural College, the S.E.A. College, Wye, and the Chelmsford Farm Institute paid visits, as did parties of Kent School Teachers.

Thus it can be fairly claimed that East Malling appeals to, and has to cater for, a great variety of tastes. There is an almost ceaseless call for the presentation of its findings first from one point of view and then another.

When it is remembered that, owing to the isolated position of the Station, at least some elementary form of hospitality has been shown to the vast majority of these 1,400 visitors, and, on many occasions, both luncheons and teas provided, the administrative work involved can be appreciated.

Library.

The funds available for library maintenance necessarily limit the extent of expansion which is desirable and, in consequence, the waiting list, both with regard to books and periodicals, has been considerably extended during the year. A small grant under the Empire Marketing Board Scheme will, however, be of assistance in future.

The Library has been increasingly used for references throughout the year, the record of borrowing does not give the details of reference books in use departmentally, but they show that during the year 90 books and 476 periodicals and reports were borrowed by members of staff.

Loans and donations are especially welcome in view of our restricted facilities.

We have again to acknowledge Mr. H. R. Beeton's kindness in keeping us supplied with the " Journal of Heredity," and Mr. N. B. Bagenal has kindly presented a copy of Grove's " British Rust Fungi."

Advantage has been taken of the generosity of the Rothamsted Library, and of the Science Library, South Kensington, from both of which loans have been obtained.

Membership Scheme.

The Scheme of Associate Membership has now been in operation for a full year, during which period seventy-nine members were enrolled. The income during the year amounted to £280 10s. 1d.

If at least this annual sum can be maintained, it will provide sufficient funds to render the scheme self-supporting by paying for the publications circulated to members, but it is hoped that some surplus may accumulate which

can be applied to the maintenance of the fabric of the Research Station, as was originally intended.

Endowment Fund.

During the past year, a small group of well wishers, inspired by the example of Sir Bernard Greenwell, have opened a trust fund which they intend shall ultimately be applied as an Endowment for the Station in times of need. Such an Endowment is indeed urgently required to relieve the Station from its not infrequent embarrassments, and to permit of its normal developments. It is now a definite part of the policy of the Ministry of Agriculture to encourage such movements, as is shown by the recent official announcement that: "The main need of the Research Institutes is now the provision of endowment funds. The Ministry has been able to make a £ for £ contribution to the endowment fund of the National Institute for Research in Dairying, which now stands at about £16,500. It is much to be desired that similar funds should be instituted at every Research Institute, and that the endowments already in existence should be greatly increased. Not only has the assistance from the Exchequer reached its limit, at any rate for the time being, but it is undesirable that autonomous research institutions should be permanently dependent for practically the whole of their maintenance upon public funds; and this is at present the case with the majority. The proportion which should be established between State grants and private income should, it has been suggested, be about two to one; even that may be theoretically too high a proportion to be borne by the State, but at present it is a rather remote ideal. The point to make is that the future expansion of agricultural research must depend to a much greater extent than in the past upon private generosity or upon the financial assistance of agriculturists who find that research 'pays.'"*

Administrative Work.

The year has been an exceptionally busy one for the administrative staff, and it was not until late in the year that additional help could be given. In October, Miss E. M. Lawson joined the clerical staff, and, in November, Mr. P. R. Wood was appointed to take over the Book-keeping.

The general correspondence during the year increased from approximately six to nine thousand communications. The Associate Membership Scheme, the enlarged mailing list, and the heavy applications for the new staff appointments all added considerably to the clerical work. The output of reports of investigations, requiring to be typed, has again been considerable, and the amount of matter requiring to be stencilled for circulation heavy.

* Report on the work of the Intelligence Department of the Ministry, 1927.

Our various Capital and Maintenance Accounts have naturally increased with all our fresh activities. The number of telephone calls exceeded that of last year by some 650.

As is mentioned elsewhere, the entertainment of visitors has been exceptionally heavy during the year, and the large parties, coupled with the unsettled climatic conditions, made it all the more arduous for those responsible for their entertainment.

Finally the removal into, and equipment of the new administrative quarters were additional responsibilities in so busy a year, but the more comfortable and convenient conditions have made possible more pleasant and more efficient work, and the administrative Staff are once more to be congratulated on the way in which they surmounted their difficulties.

Section II

The Farm.

Section II

THE FARM.

Many of the Fruit Plots at the Station have reached a stage when heavy yields may be anticipated.

During the early part of the blossoming season, there was every promise that this expectation would be fulfilled in 1927, but the two severe frosts on the nights of April 27th and 30th decreed otherwise.

Both Plums and Pears, which blossomed profusely, were almost entirely destroyed.

The damage to Apples was somewhat variable. Whilst many varieties, such as Lane's, Worcester, Allington, Rival and Early Victoria gave fair crops, Bramley's Seedling failed completely.

Soft Fruit was, in many instances, also damaged. The Red Currant and Gooseberry crops were both considerably reduced, the latter to such an extent that the thinning experiments could not be carried out as in previous seasons. Frosted fruits were apparent on many varieties. Black Currants, although showing some damage from the frosts, were once more our most satisfactory crop. Baldwin again gave the heaviest yield and Boskoop Giant the lowest.

The earliest flowers of Raspberries were, in many instances, frozen, but continued showers later helped to prolong the season, and quite average crops were gathered. The wet weather, however, made impossible the marketing of much of the fruit in first-class condition.

The plantation of Morella Cherries gave their first substantial crop, and some first-class fruit was marketed and realised satisfactory prices.

The special plantation of dessert apples on Jaune de Metz Stock planted out in 1925, yielded sufficient fruit in many cases to give a preliminary idea both of the quality and market value of some of the varieties under trial. Laxton's Superb and Ellison's Orange both cropped well and showed market promise, whilst Sturmer Pippin and Orleans Reinette also bore witness to the influence of No. IX stock on early bearing.

Experiments on fruit thinning were continued during the year, and special attention was again paid to proper grading, packing and presentation for market. Our Marketing Officer is now able to keep in closer touch with the markets by periodic visits.

This season we have had the loan of a "Cutler" Fruit Grader, which has afforded opportunity for gaining experience in up-to-date grading, and greatly facilitated the handling of our individual tree crop records. We are indebted to Dr. West, of the Low Temperature Station, Cambridge, for making this arrangement possible. The poor prices ruling for low grade apples was a marked feature of the

season's operations, but good quality apples, attractively presented, rarely failed to bring adequate returns.

Wet weather and lack of sunshine were detrimental to the full development of the Hops, besides favouring the rapid spread of Downy Mildew. With the exception of the variety Tutsham, our three acre garden of which gave 24 cwt. per acre, our yields were generally below our average. A portion of the original acre of Hops planted in 1914 on Great East Field was grubbed and is being planted with cordon Apples of dessert varieties on Jaune de Metz Stock.

Of the newly acquired Church Fields, some fourteen acres was sown with corn ; ten acres being drilled in winter with Oats and Wheat, and four acres with Spring Oats. This latter piece is in preparation for manurial trials with apples, and an effort is being made, by growing successional straw crops, to run the land out. Prior to harvesting the Oats on this ground, it was marked out into one-fiftieth of an acre plots, and the produce from each plot cut and weighed separately. It is hoped in this way to get some idea of the soil variation, as shown by a straw crop, over the area before putting it to its ultimate experimental use. The remaining six acres of Church Fields was planted with four-year half-standard Allington Pippin and Newton Wonder Apples, on Malling layered free stocks. A first trial of three-year half-standard Dr. Jules Guyot Pears was interplanted. These latter are all worked on vegetatively raised Pear stocks selected by East Malling, and are probably unique as the first extensive planting of Pears on layered Pear stocks. Lane's Prince Albert, on some of the Long Ashton and East Malling selections of vigorous apple stocks, were planted as fillers between the half standard trees. The alleys between the trees were cropped with British Queen Potatoes, which were used for spraying trials. These trials have now reached their tenth and final year. On lifting the potatoes in October, a portion of the land was immediately planted with Royal Sovereign Strawberries. The remaining portion will be spring planted, and the whole will be closely recorded in an attempt to build up healthy strains for testing out various cultural problems under Kent conditions.

Newgates Field, the twenty-five acres acquired under the Empire Marketing Board Scheme, only came into our possession in October. The whole area was at the time of purchase, planted up with small fruit, of which some eight acres has had to be immediately cleared, to make room for the extension of our stoolbeds.

The remaining portion is fortunately planted up with good strains of Baldwin Blacks (six acres), Lloyd George Raspberries (four acres), and Pyne's Royal Raspberries (six). These areas will be immediately utilised for manurial field trials, until such time as the nursery requirements indicate their discontinuance.

During the past year a Fordson Tractor (with simplex conversions), suitable for working under low trees, was purchased, and used successfully on many of the plots, especially those from which the small fruit intercrops have now been grubbed.

SECTION III

BRIEF PROGRESS REPORT OF INVESTIGATIONS AND SUMMARIES FOR FRUIT GROWERS.

Part I

Pomology.

Part I

POMOLOGY.

General.

An opportunity arose, during the year, through a request from the Empire Marketing Board, to make a general review of the first fourteen years pomological work.

This took the form of a Memorandum upon the Standardisation of Horticultural Material by Selection and Vegetative Propagation. Two aspects of our investigations stand out most clearly in these early years. In the case of those fruit plants grown upon their own roots, such as raspberries and currants, the most frequent source of economic loss and miscalculation has been shown to be the result of mixtures of varieties (often with worthless seedlings), and errors in nomenclature, which, between them, have prevented a realisation of varietal potentialities. In the case of the grafted and budded fruit plants, this was generally negligible so far as the scion was concerned; but the main source of loss has been the use of mixed, misnamed, worthless, and unsuitable rootstocks, since their influence on the worked tree has never been fully realised.

A far wider application of the method of selection and subsequent vegetative propagation is urged as a means of obtaining a much more complete control over the material used by the Horticulturist, be he nurseryman, grower or investigator.

(a.) In Relation to Tree Fruits.

Root Stock Investigations.

Stocks for Apples.

The aspect of rootstock effect on colour and size of Apples was reported upon. There is evidence that both these qualities are materially influenced by rootstock; these facts appear worthy of growers' consideration when planning new plantations.

Stocks for Plums.

The report prepared during 1926 was held back for the incorporation of a further season's records, but has now gone forward for publication. Some rootstocks are outstanding for vigour, some for early bearing, some for suckering, and some for their general utility, or incompatibility in the Nursery. The accumulated facts point to the extended use of Pershore, Common Mussel, Brompton and even some new selections, in preference to the much used Brussel, Common Plum, and Myrobolan Seedlings.

Stocks for Cherries.

Acid Cherries (P. Cerasus).

The plantation of Morellos on various stocks produced its first good crop in 1927, and suggested that quantity and size of fruit, and time of ripening, may be affected by rootstock. An effect on habit of growth was also very clearly visible.

Reciprocal Effect of the Scion upon the Root.

During the year, a considerable number of one- and two-year old trees of six varieties upon four rootstocks (I, II, VI and IX) were lifted, and the roots were carefully analysed and graded, with controls, i.e., unworked stocks. The object was to check our early conclusions (published in 1923) that though different scions may and do have different effects upon the same rootstock, these seem to be, at least in young trees, subordinate to the general character of the particular rootstock. Although the mass of figures has not yet been fully analysed, these earlier conclusions are very generally still further borne out. A series of three-year-old trees of two varieties grafted upon piece roots of two varieties of root stock—to eliminate all stock stem—were also lifted for examination, but unfortunately in all cases the scions—even of Bramley's Seedling—had themselves rooted so strongly, that the original piece roots had become quite subordinate, and so they were useless for analysis of scion effect on root. In consequence, this part of the experiment is being repeated for a third time.

A far higher percentage of scions rooted strongly than was the case in our earlier experiments reported upon in 1923, but then this series of trees dug up in the spring of 1927 had remained undisturbed for three years instead of two and one respectively.

Effects of Various Times, Degrees and Methods of Branch Pruning upon Root Development.

An interesting sidelight upon Nursery practice, and possibly also upon summer pinching, was shed by some experiments designed to elucidate the effect of branch pruning upon root development.

Considerable series of apple trees in their second year's growth were subjected to defeathering of the stems in summer, with a markedly adverse effect upon their weight, girth and root development, and no compensating increase in the growth of leading branches in the head.

The Double-working of Fruit Trees.

Pears.

A report has been published showing that the variety used as intermediate in double working has a distinct influence upon the vigour of the second scion.

This influence is not necessarily directly correlated with the vigour of the variety used as intermediate. For instance, whilst such intermediates as Fertility and Beurre d'Amanlis (as would be expected) produce vigour in the second scion, such a vigorous variety as Catillac, when used as an intermediate, appears in some cases to dwarf the tree. There are also signs that the intermediate has an influence on the age at which the tree begins to bear fruit.

Pruning Experiments.

Pears.

The different methods of pruning have now been carried out for three consecutive seasons, and the preliminary results of the various treatments will be published in detail shortly.

As with Apples, leader pruning has, in the case of twelve varieties under experiment, delayed blossom production, varying in degree with the amount of pruning and the variety.

Untipped trees have, in all cases but one, blossomed profusely, and, in some cases, carried fruit despite adverse seasons. These trees have afforded excellent material for the study of varietal habit, character and the position of the blossom trusses. They show a wide range of variation in these respects. The lack of tipping has, on the other hand, favoured the spread of scab on some varieties.

Although the leader tipped and spurred trees have produced little or no blossom up to the end of the sixth year, the effect upon the production of potential fruit buds has been very marked.

The dying out of very hard spurred laterals, or the alternative excessive wood growth resulting, which is so common in apples, seems less frequent in the case of Pears, especially when the leaders are not tipped excessively.

Although, as noted last year, the size of the untipped trees, as indicated by height and spread measurements, is greater than that of the tipped trees, the actual total amount of wood growth of the latter has in all cases exceeded that of the former. The girth of stem on the other hand has, up to the present, been greater on the untipped trees.

Plums.

The series of Victoria Plums pruned at three different periods, January, May, and August respectively, have now been under treatment for five seasons. In no case has Silver Leaf supervened, but the results of the differential treatments deserve mention.

There would appear to be no difference resulting from the January and August prunings, so far as the growth of the tree is concerned, and since the latter should be a safer period from the point of view of infection of Stereum

Purpureum, it can, under our conditions, be recommended with confidence as the better time to prune young trees.

On the other hand, the May pruning has had a very marked effect upon the general growth of the tree, and although it suggests a possible method which could be adapted to over vigorous varieties, it needs much greater consideration before recommending it generally.

The series of Czar Plums pruned with different degrees of severity [Leaders untipped (no pruning), Leaders cut back one-third, and Leaders cut back two-thirds] has produced rather unexpected results in one direction. Again, no Silver Leaf has appeared in any of the trees, and once again the unpruned series of trees show the tendency apparent in apples and pears, of early cropping.

On the other hand, the lightly tipped leaders have produced many more lateral growths than have those cut very hard, thus necessitating far more pruning cuts in ultimate thinning operations. It would appear, therefore, that if young plum trees are to be pruned in the early years, the harder method would be more desirable from the point of view of Silver Leaf infection.

Fruit Thinning.

These investigations are being developed in the case of Apples with a view to testing the effect on :

(*a*) Size, colour and general quality of the fruit.
(*b*) Regularity of bearing.
(*c*) Vigour of tree.
(*d*) Incidence of such diseases and pests as brown rot and sawfly, etc.

Manuring of Apples.

The accumulated effect of the application of Sulphate of Potash to apple trees in four of the last five winters has now become extremely striking, not only in much healthier foliage, but in much more vigorous growth, and heavier crops of larger fruit. A report of this work is shortly going forward for publication.

(b.) In Relation to Bush Fruits.

Black Currants.

Two out of the three papers upon the subject of Reversion have now been published. The first dealt with experiments on the transmission of the disease, and presented the evidence in favour of transmission by Gall Mites. It also showed how easily the trouble was transmitted by grafting, in all probability independently of Gall Mites. During the year, successful transmissions were effected by the use of intermediate reverted scions from which all buds had been removed to minimise any possibility of mite infection.

The second paper summarised the various methods of identifying the disease, and emphasised the need for studying the symptoms according to variety. Ways of distinguishing "false" from true reversion with certainty were described, and the various causes of the former discussed.

Red Currants.

Further new collections have been obtained, and the preliminary descriptions have shown that many are wrongly named, and in some cases mixed.

An attempt has been made to devise a method of identification in the Nursery Bed, and has been used with some success on the principal commercial varieties.

A survey of a number of commercial plantations was made, and revealed a state of widespread confusion. An unmixed plantation was rarely found, many plantations consisting of no less than five varieties of very different season and economic value intermixed. Under such a state of affairs wrong naming was naturally very common. In several instances the failure of Raby Castle to crop was recorded.

Walnuts.

Some progress has been made in raising clone races of rootstocks from selected individuals of different species and varieties by means of green wood cuttings.

The very severe spring frosts of April 27th to May 1st, 1927, killed outright many of the young grafted trees, forming the nucleus of a variety collection, after they had started into growth. However, this unfortunate experience afforded some valuable data about hardiness. Six varieties, Franquette, Mayette, Meylanaise, Parisienne, Treyve and Vourey, which were still practically dormant, remained uninjured, and the grafts of these trees had come from several sources.

PUBLICATIONS DURING THE YEAR.

A.7. Annual Report for 1925 (Thirteenth Year). II. Supplement, March, 1927.
A.8. Annual Report for 1926 (Fourteenth Year). I. General, May, 1927.

Pomology.

Amos, J., Hatton, R. G., Mackenzie, A. D. The Incidence of "Die Back" Disease in Plum Trees in the Field. Ann. Rept., E.M.R.S., A.7. p. 33, March, 1927.

Amos, J., Hatton, R. G. Reversion in Black Currants. I. Symptoms and Diagnosis of the Disease. Journal of Pomology and Hort. Science, VI., p. 167, September, 1927.

Grubb, N. H. Experiments with Double-Worked Pears on Quince Stocks. Ann. Rept. E.M.R.S., A.7. p. 11, March, 1927.

Hatton, R. G. The Influence of Different Rootstocks upon the Vigour and Productivity of the Variety Budded or Grafted Thereon. Journal of Pomology and Hort. Science, VI., p. 1, February, 1927.

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"REVERSION" IN BLACK CURRANTS.
ITS CAUSES AND ERADICATION.

By J. AMOS, R. G. HATTON, R. C. KNIGHT and A. M. MASSEE.*

At any rate as far back as 1912 the trouble now commonly referred to as "Reversion" was becoming well-known to black currant growers. A tour of black currant plantations to-day provides ample evidence that the trouble is now almost universally widespread. Indeed in the light of the amount of fresh knowledge now available upon the subject, it is disappointing to find so many commercial currant plantations, belonging to up-to-date growers, containing anything from five to fifty per cent. "reverted" or "reverting" bushes. The seriousness of this state of affairs is two-fold. The "reverted" bushes, in the vast majority of cases, soon cease to bear any crop at all, and nevertheless, they are sources of further infection.

The Causes of Reversion.

Although research workers have still some details to fill into the picture, the general outline of the character of this disease is now clear enough. It has been proved that "reversion" is not merely a "running wild" of the bush or strain, but that it is a disorder that can be communicated from bush to bush.

In order to be certain of the facts, experiments have been repeated in four successive years in which healthy and "reverted" portions of black currant bushes were brought into direct contact. To produce this contact reverted shoots were grafted on to healthy bushes, and vice versa. Again, healthy and "reverted" bushes were "inarched." In other cases, green wood grafting was performed. In yet other cases, mere lengths of wood, stripped of all buds, but taken from a reverted bush, were used as intermediate grafts, between healthy root-stock and scion. In practically 100 per cent. of the cases, the "reversion" symptoms were transmitted from the diseased to the healthy unit within a period of eighteen months. On the other hand, it was proved that the mere act of grafting was not responsible, since healthy shoots grafted on healthy bushes remained healthy (1).

The large number of bushes used in these experiments, and the frequent repetitions under varying conditions, of the same results, leave no possible doubt but that *reversion is a disease which can be transmitted from bush to bush.*

At present it is not known exactly what is transmitted, probably because the cause of the disease is in the living cell, and of a nature which cannot yet be detected even microscopically.

* Reprinted from the Kent Cherry and Soft Fruit Show Catalogue, July 15th, 1927.

It is probably similar in nature to the " virus " diseases, such as Mosaic of Potatoes, Tomatoes, Raspberries or Hops.

The " Carrier " of Reversion.

Now, since the practical grower does not go about grafting " reverted " scions upon his healthy bushes, the question at once arises as to how this insidious disease is transmitted from bush to bush under natural conditions. On analogy with the leaf curl of the potato, one would expect to find a natural carrier of the disease in the form of some insect.

It has now been proved beyond doubt that *at least one agent of the transmission of reversion is the Big Bud Mite* (1). For three years in succession considerable numbers of healthy young black currant bushes have been directly infected with black currant mites, whilst similar series of bushes have been kept as free from them as possible by frequent sprayings. Although here and there a single bush has shown a high degree of resistance, overwhelming evidence has been produced to prove that the Big Bud Mite plays an important part in transmitting reversion.

Sufficient evidence is as yet not available to show whether other forms of mite which live on the black currant, or aphids and capsids can also act as " carriers." It is as least possible, so that the danger of leaving " reverted " material in the plantation becomes very great.

Growers often live in a sense of false security over the matter of big bud mite, and they congratulate themselves that the attack in their plantations is slight, because they can see but few " big buds " or none at all. It is now known that these *Mites are very commonly present upon bushes which do not manifest big buds at all* (6).

Some diseases of the mosaic type are so infectious that it is enough to pinch an infected leaf and then a healthy one to transmit the trouble.

In other cases, the pruning knife or hoe may be a mechanical spreader. There is as yet insufficient evidence to say whether this is true in the case of the black currant.

Prevention and Control of the Disease.

In the light of the foregoing information, there are two obvious parallel lines along which the grower can proceed.

First, *he must control the attacks of Big Bud Mite*, and *other insects as potential carriers of the disease.*

Secondly, he *must eliminate the sources of infection from his plantations.*

Though the complete control of big bud mite is exceedingly difficult owing to its continuous migrations during the fruiting period, a very close approximation

to a perfect control has been found. If the bushes are sprayed with winter-strength lime sulphur (s.g. 1.025, approximately one gallon concentrate in twelve of water), when the leaves are about the size of a shilling, and the blossom trusses just appearing, a very large measure of control will result (5). The bushes will be covered with a sulphur deposit, which is deadly to mite life, at the latest possible moment from a cultural point of view, and just when mite migration is in full swing.

Some marginal leaf scorching will result, especially on varieties of the Goliath Group (Victoria, Edina, and Monarch), but no measurable ultimate loss of vigour or crop has been recorded which can outweigh the advantages of mite control. It is probably advisable, however, in the case of this Group to reduce the strength of the application to one gallon Lime-Sulphur in twenty of water, though it will be in consequence less effective.

With the tar distillate washes and with soft soap and nicotine, the vigilant grower is well armed against Aphids and Capsids. In the latter case, strong nicotine is the only proved control. Though such a spraying campaign may be regarded as extravagant, on the other hand a full crop of black currants is worth bringing home.

In the second place, *the sources of infection must be removed*. The symptoms of " reversion " have now been sufficiently clearly described to enable any Black Currant Grower, who knows his varieties and will give the matter a few days' study, to detect diseased bushes with a ninety-nine per cent. accuracy.

It is only necessary to examine, in June and July, the leaf characters of the main growths, provided the bushes have been kept free from insect attacks (4). Simple methods for distinguishing true and false reversion have now been described (2).

If a point is made of roguing the plantations before the crop is picked, the decreased fertility of the reverted bushes and branches will give an additional rough clue. It has been found that if roguing is carried out regularly at this season, and all *reverted branches and bushes automatically cut out when diagnosed, the spread within a plantation can be very effectively prevented.*

It has also been proved to be perfectly safe to plant a healthy young bush in the place whence a reverted one has been grubbed.

Each year such roguing becomes a quicker and more certain operation, and its results become very apparent not only by arresting the spread of the trouble in the plantation, but in the freedom of cutting beds. In four or five years, to all intents and purposes, reversion-free strains of any variety can be built up, and thus good plantations assured.

It is especially necessary to rogue all parent bushes from which cuttings are to be obtained, and it is therefore advisable in the main to take cuttings from bushes up to four or five years old, which are not too crowded to allow of efficient

roguing. Finally, it is dangerous to take cuttings even from apparently healthy branches of partially reverting bushes, for they often manifest the disease later.

The position is so clear to-day that the roguing of black currant plantations can be undertaken with considerable accuracy, and in cases of nursery stock showing a reasonable standard of freedom from the disease, the Ministry of Agriculture are prepared to issue to growers certificates which serve as a guarantee to buyers.

If then, growers would only adopt these unheroic methods, of buying or raising stock fit for certification, of subsequent roguing of plantations, and of control of Big Bud, Aphis and Capsid, the growing of black currants would be a much more satisfactory industry.

See the following Publications:

(1) Experiments in the Transmission of "Reversion" in Black Currants. By J. Amos, R. G. Hatton, R. C. Knight, and A. M. Massee. (Annual Report, East Malling Research Station, II. Supplement, March, 1927.)

(2) "Reversion" of Black Currants. Part I. Symptoms and Diagnosis of the Disease. By J. Amos and R. G. Hatton. (Journal of Pomology and Horticultural Science. Vol. IV., No. 3. July, 1927.)

(3) "Reversion" of Black Currants. Part II. Its incidence and spread in the field in relation to possible control measures. By J. Amos and R. G. Hatton. (Journal of Pomology and Horticultural Science. Vol. VI., No. 4. February, 1928.)

(4) "Reversion" or "Nettlehead" of Black Currant. Leaflet No. 377, Ministry of Agriculture and Fisheries (revised edition).

(5) The Control of Black Currant Gall Mite. By A. M. Massee. (Annual Report East Malling Research Station, I. General, June, 1926.)

(6) Observations on the Presence of Mites upon Black Currant Bushes manifesting Reversion and Big Bud. By A. M. Massee. (Annual Report East Malling Research Station, II. Supplement, March, 1927.)

Part II

Physiology.

Part II

PHYSIOLOGY.

Propagation.

(*a*) *Hardwood Cuttings.*

The influence of external conditions upon callus development and root formation in hardwood cuttings has been followed in more detail than hitherto and it has been found that the increase in callus development in a wet substratum occurs chiefly in the early stages.

When planting is done in late September the wet substratum cuttings are better callused than those in a drier medium at the end of October. After this date, cuttings under drier conditions steadily gain on the others and by the end of January they are considerably the more forward.

It has already been pointed out that hardwood cuttings planted in sand should be heavily watered during the callusing period, and the further investigation indicates that particular attention should be given during the first month after planting.

(*b*) *Softwood Cuttings.*

It is, of course, doubtful whether this method of propagation can be of economic value in its application to fruit tree rootstocks except for varieties which are obtained otherwise only with great difficulty, although it is of great value in producing material for experimental purposes.

In this method external conditions are under much closer control than when hardwood cuttings are planted in the open. Further, the material available for softwood cuttings is far from being physiologically uniform owing to the parent plants being in active growth. Particular attention has been paid in experiments on softwood cuttings, to the condition of the cutting, the date of planting and the planting medium. Greatest success has been obtained when stems which have just ceased active growth are planted as early in the season as they are obtainable. A variety of planting media have been tried, but none has been found to be consistently better than sand, although, occasionally equally good results have been obtained with mixtures of coconut fibre, soil, etc.

Growth.

A report has been published showing the close relationship between new shoot growth and the thickening of the older stems of the apple. The results obtained elucidate in some degree the reduction in the thickening of stems which follows the continued removal of lateral growths.

The process of thickening as influenced by shoot growth has been followed continuously through the main stem to the root system of the tree.

In this connection also, observations have been made on the relation between scion growth and the development of new tissues in graft unions.

NATURE OF STOCK INFLUENCE.

A preliminary report on experiments on the nature of stock influence has been published. The general conclusion is that the stem portion, as well as the root system, may have some influence on the scion. Purely quantitative differences between rootstocks appear to play a small part in producing scion differences.

REVERSION.

Experiments on the transmission of reversion have failed to convey the disease from one plant to another by means of exuded sap. A report on this work is incorporated in a joint paper on reversion.

PUBLICATIONS DURING THE YEAR.

Knight, R. C., Witt, A. W. The Propagation of Fruit Tree Stocks by Stem Cuttings. II. Trials with Hard- and Soft wood cuttings. Journal of Pomology and Hort. Science, VI., p. 47, February, 1927.

Knight, R. C. The Relation in the Apple between the Development of Young Shoots and the Thickening of Older Stems. Journal of Pomology and Hort. Science, VI., p. 72, February, 1927.

Knight, R. C. Preliminary Observations on the Causes of Stock Influence in Apples. Ann. Rept. E.M.R.S., A.7. p. 51, March, 1927.

Knight, R. C. Observations on the Water Conductivity of the Stems of Reverted Black Currants. Ann. Rept. E.M.R.S., A.7. p. 70, March, 1927.

Part III

Plant Pathology.

Part III

PLANT PATHOLOGY.

1. Crown Gall.

In connection with the Crown-gall problem of nursery stocks attempts have been made to isolate gall-producing organisms from galls on various hosts. An organism has been isolated from a gall found on a Dock, and the same or a closely related organism from a gall found on a raspberry stem. Both these strains were found to produce galls when inoculated into tomato stems.

2. Brown Rot Diseases.

In continuation of the systematic study of the Brown Rot fungi and their distribution, specimens of diseased peaches imported from the United States were examined. Cultural studies, for identification, showed that they were infected with *Sclerotinia americana*, the Brown Rot fungus common and destructive in America but not found in this country. This result indicates the necessity for taking precautions to prevent the importation of such infected fruit.

3. Effect of Root Stock on the Susceptibility of the Scion.

Observations on Apple Mildew and Apple Scab offer further evidence that the stock to some extent influences the degree of infection. (See below, 8. Apple Spraying Field Trials.)

4. Raspberry Diseases.

(1) *Blue Stripe Wilt.* A comparison of the species of *Verticillium* causing this disease with species isolated from other plants indicates that the fungus corresponds closely with descriptions of *Verticillium Dahliæ* Kleb.

The results of an experiment in the artificial infection of seedling raspberries raised in rich and poor types of soil respectively, and a further year's records on the field experimental plots (designed to determine the effect of propagating from stools showing disease symptoms, and from healthy stools) show that when a stool is infected with the fungus causing Blue Stripe Wilt, the killing or weakening of the canes (as distinct from the underground root-stem system) does not necessarily follow as a matter of course but is dependent upon very specialised external conditions (e.g., soil, temperature, moisture, etc.). Stools which show the disease one year may, therefore, be apparently normal the next year, and stools showing slight symptoms may, if divided and planted under other conditions, grow away quite normally.

(2) *Cane and Leaf Spot (Anthracnose).* Records of cane growth and crop weight taken on the plot of raspberries (var. Baumforth Seedling B) sprayed in 1926, some rows with Lime Sulphur (two applications at 1:10 and 1:40 strength respectively) and others with Bordeaux Mixture (two applications at 12:12:100 and 6:6:100 strengths respectively) show that the spraying has resulted in a considerable increase in the vigour of growth of the cane and a corresponding increase in the weight of the fruit crop, the crop on the sprayed rows being approximately 50 per cent. greater than that on the unsprayed rows.

A further spraying trial carried out in 1927, when Lime Sulphur only was used, shows that all spray scorching of canes caused by the first (delayed dormant) application of the Lime Sulphur, can be avoided if the spray is applied when the cane buds have pushed out to a distance not exceeding half an inch. This experiment also tends to show that each of the two applications (delayed dormant and pre-blossom) plays its part in controlling the disease and therefore that both should be used.

(3) *Mosaic.* Further experiments in the transmission of the disease by grafting confirm the conclusions tentatively drawn from the 1926 experiment, namely that, in the case of the variety *Baumforth Seedling B*, the disease can be transmitted to healthy stools by this means, thus providing additional evidence for including the disease among the Virus Diseases.

(4) *Spur Blight.* The artificial inoculation of canes (*a*) with a pure culture of a fungus obtained by direct isolation from discoloured patches of bark on young canes and (*b*) with a culture obtained from a single ascospore of the fungus *Didymella applanata* (Niessl.) Sacc. has given positive and identical results thus showing that the discoloured patches common on young canes, and associated with Spur Blight, indicate an early stage of infection by *Didymella applanata.*

Up to the present time no field experiments on control have been carried out. A study of the disease in the field, however, suggests certain precautionary measures against it. There is evidence that young canes are infected by spores produced from fructifications of the fungus appearing on lesions on the fruiting canes. It would therefore be advisable to remove as many badly diseased canes as possible during the spring thinning of the stools.

A drastic thinning of cane should also promote aeration of the stools, which should be perpetuated by a periodic hoeing out of superfluous spawn throughout the growing season.

5. Bacteriosis of Plum and Cherry Trees.

Cultural and inoculation experiments have been continued with the organisms found associated with (1) Bacterial shoot wilt of plum trees and (2) Leaf Spot and Gummosis of Cherry Trees. A comparison of results obtained

in 1926 and 1927 indicates that the rainfall in spring is an important factor influencing the degree of infection by the organisms causing these diseases.

Isolation and inoculation experiments carried out to ascertain the cause of "Die-back" in plum and cherry trees have shown that the disease can be brought about by inoculations with bacteria isolated from stem cankers, and from leaf spots. Evidence has been obtained that successful infection can be induced in the autumn, and this has been followed up by spraying trials in the autumn to determine whether spraying at that time of the year will control the disease.

An organism has been isolated from a peach tree showing "die-back" symptoms and this is being compared culturally and by inoculations with strains obtained from plum and cherry trees.

6. Hop Wilt.

Further inoculation experiments with the species of Verticillium associated with this disease have been carried out and evidence of the parasitic nature of the organism has now been obtained. The factors which influence the intensity of attack are being studied with a view to controlling the disease by field cultural methods. A field trial is under way.

A comparison of the organism (microscopically and in pure culture) with other strains of Verticillium shows that the Hop Wilt organism conforms with descriptions of *Verticillium albo-atrum* Rke and Berth.

7. Walnut Bacteriosis.

Further inoculation and cultural studies of the organism isolated from lesions on Walnut leaves at East Malling, offer confirmation of the evidence obtained last year that the organism is similar to that causing "Walnut Blight" in America.

8. Apple Spraying Field Trials.

Most of the trees, on the plot reserved for spraying trials, are still too young for the records obtained from the fruit to be reliable, but Bordeaux Mixture and Lime Sulphur both showed marked control of scab on the young shoots of Cox's Orange Pippin, when used as post-blossoming applications with or without the addition of lead arsenate.

There are indications that the degree of infection of Scab and Mildew varies to some extent with the stock on which the scion is worked, thus the trees of Cox's Orange Pippin on Type XVI. showed less infection of Apple Scab than those on Type II., IX. or I.; the same variety on Type I. or II. shows more infection of Apple Mildew than when worked on Type IX. or XVI.

On Cox's Orange Pippin no serious spray injury was caused in 1927 by any spray. On Stirling Castle, however, the excessive leaf-fall induced by the sprays containing Sulphur has resulted in a pronounced stunting of the trees.

PUBLICATIONS DURING THE YEAR.

H. Wormald. Further Studies of the Brown-rot Fungi II. A Contribution to our Knowledge of the Distribution of the Species of Sclerotinia causing Brown-rot. Annals of Botany, Vol. XLI., No. 162, April, 1927.

H. Wormald. Canker in Fertility Pear Trees. Journ. Min. Agric., Vol. XXXIV., No. 2, May, 1927.

H. Wormald. Brown Rot of Apples ; the Need for careful Picking and Sorting. Journ. Min. Agric., Vol. XXXIV., No. 6, Sept., 1927.

H. Wormald. Brown Rot Diseases of Fruit Trees in 1926. Gard. Chronicle, Sept. 17th, 1927.

H. Wormald. Notes on Plant Diseases in 1925. E.M.R.S. Ann. Rept. (Thirteenth Year), II. Supplement, March, 1927.

H. Wormald. A Leaf Blotch of Quince Trees. E.M.R.S. Ann. Rept. (Thirteenth Year), II. Supplement, March, 1927.

H. Wormald and R. V. Harris. Bacterial Rot of Turnips. E.M.R.S. Ann. Rept. (Thirteenth Year), II. Supplement, March, 1927.

R. V. Harris. A Wilt Disease of Hops. E.M.R.S. Ann. Rept. (Thirteenth Year), II. Supplement, March, 1927.

H. Wormald. A Disease of the Shasta Daisy. E.M.R.S. Ann. Rept. (Thirteenth Year), II. Supplement, March, 1927.

RASPBERRY CANE SPOT AND ITS CONTROL.

By R. V. HARRIS.

(1) Introduction.

The writer's attention was directed to this disease in the season of 1924 when the rows of the variety *Baumforth's Seedling B.* on the trial plots at East Malling were very seriously attacked. As a result of this attack the growth of the new cane was much impeded (the majority of the canes not exceeding 2 ft. in length at the end of the season), many canes died back from the tip, and the crop in 1925 was so small as to be negligible.

The chief symptom is a spotting of the leaves and the stems of the canes. Spots which appear early in the season subsequently become sunken, forming deep pits in the tissues of cane (Fig. 1), and where such infections are very numerous, irregularly shaped cankers are formed (Fig. 2). Other spots appearing later in the season remain purely superficial (Fig. 3). These spots are very inconspicuous but nevertheless produce large numbers of spores which infect other canes.

Cases of badly cankered canes with their upper part dead are very common (Fig. 4), and in any case the growth and development of such canes is poor. Also in the spring following the year of attack, many of their buds fail to grow out, and the majority of those that do develop, produce very small and unproductive laterals. Badly cankered canes also are commonly very distorted and twisted, an extreme case giving the appearance of an attempt to tie the cane in a knot.

For a more detailed description of the symptoms of the disease, the reader is referred to an article which appeared in the Annual Report of this Station for 1925.*

In the present article, the writer proposes to deal with field control measures against the diseases which have been tested at East Malling and which can be recommended to raspberry growers on the results of these tests.

2. Susceptible Varieties.

As will be surmised from the preceding paragraphs, certain varieties have been found to be much more susceptible to the disease than others. By far the most susceptible of these, so far observed, is the important variety *Baumforth's Seedling B.*

At East Malling the stock of this variety has suffered conspicuously from the disease, and reports of similar serious attacks have been received from growers

* Three Raspberry Diseases. Annual Report, 1925, Pt. I., pp. 64-70. 1926.

and advisory officers in widespread parts of the country. The writer would go so far as to say that one of the main causes of the difficulty experienced by growers in raising a strong stock of this variety, is due to its marked susceptibility to Cane Spot. The results of spraying trials and experiments in other control measures, to be described below, show clearly, however, that the disease in this and in other highly susceptible varieties, can be adequately controlled with very little trouble and expenditure, resulting in a great improvement in the vigour of growth of the cane, and in the crop yield.

In addition to *Baumforth's Seedling B.*, the following standard commercial varieties have been found to be markedly susceptible to the disease :—

Semper Fidelis.
Readers Perfection.
Devon.

3. Direct Control Measures.

The disease is caused by a fungus (*Plectodiscella veneta* (Speg.) Burk.) which eats into the soft tissues of the cane forming the familiar spots and pit lesions. Later this fungus forms fruit bodies on these spots (mainly in the fruiting year of the cane) ; these fructifications produce the spores which carry infection to the new canes. Fortunately the fungus does not travel down the canes into the root-system, but confines its activities to small areas of the outer tissues of the cane. By removing, therefore, all the infected canes from a diseased stool, the stool is rendered free from the disease.

It follows from the foregoing that the control of the disease involves (1) the removal of spore-producing fungus bodies from the neighbourhood of the young canes, e.g., by cutting away and burning infected canes, or (2) the stopping of the production of the infecting spores by the fungus, and the protection of the young cane from attack by these spores, e.g., by the application of a spray.

Experiments on the control of the disease by such methods have been carried out, and will be discussed below.

(*a*) *Control by the cutting out and burning of diseased fruiting canes in the Spring.*

A field experiment on this method of control was carried out in 1926. A badly diseased row of the variety *Semper Fidelis* was divided into equal sections. Each of these sections was subjected to one of the following treatments at the time of the normal spring thinning of the cane.

Treatment 1.—Stool thinned to 6—8 canes, but badly pitted and cankered canes not cut away.

Treatment 2.—As 1, but in thinning, all the most badly pitted and cankered canes cut away and burnt.

Treatment 3.—All the canes cut down as close to the ground as possible and burnt.

In November, all the new canes in each section were examined individually, and the numbers of spotted and healthy canes were counted in order to find the results of the various treatments. These results are summarised in the following table.

TABLE I.

Treatment (in Spring) of Fruiting Canes.	Percentage of diseased new Canes (in Autumn.)
1. Badly diseased Canes *not* cut out ..	81
2. Badly diseased Canes cut out	61
3. All Canes cut out	13

It will be seen from the above table that by cutting out the badly cankered canes during the spring, the percentage of diseased canes was reduced from 81 to 61, that is the number of healthy canes was doubled, and by cutting down all fruiting canes the disease was practically eliminated. In the case therefore, of a very seriously diseased plantation where the cropping is of a very poor order, it might be deemed worth while to sacrifice one year's fruiting cane in order to clean up the plantation. Also this result indicates, that in planting up with canes of a susceptible variety, the infection of the new plantation can be considerably reduced by cutting the cane back as hard as possible soon after planting, and burning the cane thus cut away.

On the other hand, treatment No. 2 should, in the case of a susceptible variety, be practised every year. It should be quite easy to make the man engaged in thinning the stools familiar with the type of cankered cane to be cut out, and when this has been done no extra work is involved in addition to the ordinary routine thinning.

(*b*) *Control by the early removal of fruiting canes after cropping.*

In the study of the disease in the field it has been observed that the infection of the new canes continues until very late in the year and at least until the end of the growing season. Spots are commonly found at the tip of the latest produced canes. These very late infections in common with all the later " superficial-spot " type of infections, although they may not damage the canes to a great extent, produce spores which infect the next year's canes. There is reason to believe that a large proportion of these late infections are caused by spores produced on the old and defunct fruiting canes which have not been removed from the stools. Numbers of such canes have been examined and mature spore-producing bodies have been observed on them as late as September.

Although no experiments have yet been carried out to determine the degree of control that would be obtained by the early removal (i.e., as soon after cropping as practicable) of the old fruiting canes, the above observations are, in the present writer's opinion, sufficiently suggestive to make the measure worth while.

(*c*) *Control by Spraying.*

Field spraying trials carried out in 1926 and 1927 show clearly that in the case of the very susceptible variety *Baumforth's Seedling B.*, the disease can be controlled to a large extent by the use of *Lime Sulphur* or *Bordeaux Mixture*, the application of these sprays according to the programme detailed below, resulting in a greatly increased vigour of growth of the cane, and a corresponding increase in crop weight.

The first of these trials (that of 1926) was carried out on a three year old plantation of *Baumforth's Seedling B.*, very badly affected by cane spot. Some of the rows were sprayed with Bordeaux Mixture, others with Lime Sulphur, while the remaining rows were left unsprayed as controls. The two sprays were used with, and without, the addition of a spreader (Lime Casein being used with the Bordeaux Mixture and Gelatine with the Lime Sulphur).

There is no indication however that the spreader improved the effect of the spray in either case.

Two applications of the sprays were made during the season. The programme may be set out as follows :—

A.—First Application (delayed dormant).

1. *Time of Application* :—When cane buds had pushed out from ½ inch-1 inch.
2. *Strength of Sprays.*
   (*a*) Lime Sulphur (S.G.=33° Beaumé) :—1 gall. with 9 galls. water (=1 in 10).
   (*b*) Bordeaux Mixture :—Quick Lime 12 lbs.
   Copper Sulphate 12 lbs.
   Water 100 galls.
   (=12 : 12 : 100).

B.—Second Application (pre-blossom).

1. *Time of application* :—When first flower buds were just showing white.
2. *Strength of Sprays.*
   (*a*) Lime Sulphur :—1 gall. with 39 galls. water (=1 in 40).
   (*b*) Bordeaux Mixture :— Quick Lime 6 lbs.
   Copper Sulphate 6 lbs.
   Water 100 galls.
   (=6 : 6 : 100).

The sprays were put on with a hand power sprayer at a pressure of 70-80 lbs., and a fine nozzle was used. Great care was taken to wet each cane thoroughly from the tip to the base. The result of this trial will now be summarised.

The first application of Lime Sulphur (at 1 in 10) resulted in considerable scorching; some of the sprouting laterals were completely killed, and where a lateral did grow out, the early leaves were badly scorched. There was very little, if any injury with the Bordeaux Mixture applied at the same time. The scorching by the second or pre-blossom application of both the sprays was so slight as to be negligible.

To estimate the positive effects of the spraying on the health of the stools, series of records were taken to determine :—

(1) Percentage of diseased and healthy new canes on the sprayed and unsprayed rows at the end of the season during which the spraying was carried out.

(2) Vigour of growth of the above cane in its fruiting year, i.e., the year following the spraying year.

(3) Crop weight on sprayed and unsprayed rows (taken in the year following the spraying year).

These records are summarised in the following table.

TABLE 2.

TREATMENT.	FIRST YEAR (i.e., Year of Spraying).		SECOND YEAR (i.e., Fruiting Year).		
	% of pitted and cankered New Canes.	% of badly cankered New Canes.	Average length of Fruiting Canes after normal tipping.	Average No. of Flowering Laterals per Cane.	Weight of Crop.
			ins.		cwt. per acre
Unsprayed ..	74.5	15.3	23.5	4.0	7.98
Bordeaux Mixture 12 : 12 : 100 and 6 : 6 : 100	61.2	15.9	26.8	6.0	12.71
Lime Sulphur 1 : 10 and 1 : 40	22.4	0.6	28.5	6.6	12.19

It will be seen from the above table that, as a result of the one season's spraying with Lime Sulphur, the percentage of diseased new canes was reduced from 74.5 to 22.4 and bad cankering was practically eliminated. The average length of the new canes (the fruiting canes of the year following the spraying year) was also increased by 5 inches (the canes being measured after the normal

tipping), this increase in length being accompanied by a corresponding all round increase in vigour and an increase in the number of effective fruiting laterals of about 50 per cent. Finally, the crop of fruit on the sprayed rows (in the year following the spraying year), was approximately 50 per cent. greater than that on the unsprayed rows.

It will be seen also that the rows sprayed with Lime Sulphur yielded a slightly smaller crop than those sprayed with Bordeaux Mixture, in spite of the fact that in other respects the Lime Sulphur appears to have given a more effective control than the Bordeaux Mixture. This anomaly may be due to the direct injury to the stools caused by the delayed dormant application of Lime Sulphur.

A further trial was carried out in 1927 on another plantation of the same variety. In this trial Lime Sulphur was used, but not Bordeaux Mixture, the object being (1) to see if injury by this spray could be avoided, and effective control obtained, by applying the delayed dormant wash at a slightly earlier stage, i.e., when the cane buds had pushed out not more than half-an-inch, and (2), to see if the strength of the delayed dormant application could be reduced (thus reducing scorching), and still give effective control and (3), to determine the relative effectiveness of each of the two applications, with a view to the possibility of omitting one of them.

A complete series of records on the result of this trial are not available at the time of writing, but those already taken indicate (1) that spray injury with the 1 in 10 dormant application of Lime Sulphur can be avoided by putting on the spray at a stage when the cane buds have pushed out not more than half an inch (a slightly earlier stage than that in the 1926 trial), (2) that the 1 in 10 strength for the delayed dormant wash gives a better control than a 1 in 15, or 1 in 20 strength, and (3) that each of the applications (delayed dormant and pre-blossom) takes a considerable share in controlling the disease, and therefore that both should if possible be used (see p. 63).

On the results therefore of the two trials at present available, the following programme of spraying with Lime Sulphur is recommended :—

A.—First Application (delayed dormant).

1. *Time of application :*—When cane buds have pushed out *not more than* ½ *inch* (Fig. 5).
2. *Strength :* Lime Sulphur (Beaumé 33°) 1 gall.
   Water 9 galls.
   (=1 in 10).

B.—Second Application (pre-blossom).

1. *Time of application :* When first flower buds are just showing white.
2. *Strength :*— Lime Sulphur (Beaumé 33°) 1 gall.
   Water 39 galls.
   (=1 in 40).

Note.—The spray should be applied with a fine nozzle at a pressure not less than 70-80 lbs., and care should be taken to wet the whole of the canes, but, in the case of the first application, the basal parts of the canes in particular.

In conclusion it should be remembered that the results tabulated and described above were obtained by one season's spraying only.

If the attack of the disease is not very serious, or if for other reasons it is not found possible to make two applications of the spray, in any one season, the first, or delayed dormant application should be made, and the pre-blossom application omitted. The 1927 spraying trial showed that this application by itself gives quite good results whereas if it is omitted and the pre-blossom application alone made, the young and tender spawn may be infected before the spray is applied, and such early infections would be likely to do considerable damage.

Summary.

The control measures against Raspberry Cane Spot recommended and described above, may be summarised as follows :—

A.—*The New Plantation.*

1. Avoid planting up very susceptible varieties (see p. 57).

2. If a very susceptible variety such as *Baumforth Seedling B.* is selected or if the canes for planting show any trace of spotting, cut all the cane back as hard as possible directly after planting, and burn the cane thus cut away. (see p. 58).

B.—*The Established Plantation.*

1. Cut out and burn all the most badly cankered and spotted canes during the spring thinning of the stools (see p. 58).

2. Spray with Lime Sulphur (a delayed dormant application at 1 in 10 and a pre-blossom application at 1 in 40, applied as described on p. 62).

3. Cut out and burn, as soon after cropping as possible, all the old fruiting canes (see p. 58).

FIG. 1.
A New Cane (var. *Readers Perfection*) showing pit lesions (photographed in September), nat. size.

FIG. 2.
A badly cankered Fruiting Cane (var. *Semper Fidelis*), nat. size.

FIG. 3.
A Cane (var. *Baumforth's Seedling B*) showing the "superficial type" of spot, nat. size.

FIG. 4.
A New Cane (var. *Baumforth's Seedling B*) with spotted and dead tip.

FIG. 5.
A Fruiting Cane of *Baumforth's Seedling B*, photographed at the stage at which the delayed dormant application of the spray should be made, nat. size.

Part IV

Entomology.

Part IV

ENTOMOLOGY.

Dormant Winter Washes.

The Trials with Tar Distillate Washes were continued in collaboration with Dr. Goodwin, of S.E.A. College, Wye, only with washes of known composition, three points requiring further elucidation.

(*a*) The optimum strength for these washes. After three years' trial the $7\frac{1}{2}$ to 10 per cent. formula stands, according to the prevalence of aphis or caterpillar eggs.

(*b*) The range of boiling points in the production of these washes. Taking a range of from 200-300° C., there was not found to be any difference in their effectiveness.

(*c*) The possible inclusion of other substances with these tar distillates to render them toxic to eggs of the fruit tree red spider. The inclusion of both colloidal sulphur and naphthalene have produced negative results.

Study of Resistance of Different Varieties of certain Insect Attacks.

The studies continued this year, both in the case of the relative resistance of Apple Stocks to Aphis pomi and of Mazzard Cherry stocks to Cherry Black fly (*Myzus cerasi*), greatly add to the evidence that, given certain sets of conditions, even high degrees of resistance may be broken down at least temporarily.

Of Mr. Crane's seedlings—Northern Spy crossed Doucin II.—to have maintained immunity after very stringent indoor and outdoor inoculations with Woolly Aphis. Several others show a high degree of resistance, some on the other hand proved very susceptible.

Apple Sawfly.

It becomes more and more apparent that any successful control of this pest will be clearly correlated with a knowledge of the life history from a local standpoint. It would appear under conditions at East Malling, that the adult insects emerge and survive in any particular season during a comparatively brief period. If arsenate of lead is on the developing fruit during this period, the measure of control is found to be considerable, but there are two points with regard to its application requiring further investigation.

First, the time for applying this application will vary from season to season, with the critical stage in the life history of the insect.

Secondly, how far it is possible to make the application coincide with one of the normal fungicidal sprayings. Further work is proceeding on these lines.

Larvæ have, for the first time at East Malling, been detected in the soil at considerable depths.

Systematic Study of Gall Mites.

A report has been published showing that Gall Mites are commonly found on many varieties of Raspberry during the summer months. They are most readily found on plants showing abnormal foliage, and have caused considerable damage especially to young seedlings. The same species, which has been described from the characters of the mite, is found under similar circumstances on the Himalaya Berry and Wild Blackberry.

The life cycle of the Apple Gall Mite is being investigated and a preliminary report is in preparation.

As mentioned, under the pomological section, a report has been published on the transmission of Reversion in Black Currants. The full evidence is presented with regard to its transmission by the Big Bud Mite. Ninety per cent. of the normal bushes (some fifty in all) developed reversion after artificial infection with these mites, whilst ninety-two per cent. of the Control bushes (i.e., those not intentionally infected) never showed any signs of the trouble. There was apparently very little relation between the number of visible big buds and the intensity of the reversion symptoms.

Further observations on this Mite have revealed (*a*), that a mite population may be present on badly reverted bushes without manifesting big bud, (*b*), that this mite is sometimes to be found in apparently normal buds, and (*c*), that on varieties of the Goliath Group of Currant, apparent big buds are frequently found apart from the presence of *Eriophyes ribis*.

Certain stages in the life cycle of the free living species of Black Currant Gall Mite (*Phyllocoptes masseei*. Nalepa), are being studied with a view to ascertaining what effect, if any, it has on the plant.

Work on the Red Currant Mite (*Eriophyes ribis*), both as regards its life cycle and control, is being continued. The failure of certain Red Currant plantations—especially of Raby Castle—to crop, so often attributed to bud damage—has been proved to be due to mites destroying the buds, without causing " big buds." The same phenomenon has been noted on Gooseberries.

Raspberry " Mosaic."

The direct inoculations of raspberry canes with various insect pests has as yet, owing to extreme difficulties of technique, not yielded any definite results.

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Le Pelley, R. H. Studies on the Resistance of Apple to the Woolly Aphis. Journal of Pomology and Hort. Science, Vol. VI., p. 209, September, 1927.

Massee, A. M. Field Experiments with Dormant Winter Washes. Ann. Rept. E.M.R.S., A.7. p. 101, March, 1927.

Amos, J., Hatton, R. G., Knight, R. C. and Massee, A. M. Experiments in the Transmission of "Reversion" in Black Currants. Ann. Rept. E.M.R.S., A.7. p. 126, March, 1927.

Massee, A. M. Observations on the Presence of Mites (*Eriophyes ribis*) upon Black Currant Bushes Manifesting Reversion and Big Bud. Ann. Rept. E.M.R.S., A.7. p. 151, March, 1927.

Massee, A. M. The Gall Mites of the Himalaya Berry and Raspberry. Ann. Rept. E.M.R.S., A.7. p. 154, March, 1927.

Massee, A. M. Notes on Insects and other Pests in 1925. Ann. Rept. E.M.R.S., A.7. p. 157, March, 1927.

WINTER WASHES; MODERN DEVELOPMENTS IN THEIR USE.

By A. M. MASSEE.

The washing of fruit trees in winter has been practised in this country for many years, and in view of the developments since 1922 a brief summary of the subject may be opportune.

When applying the older types of winter washes, i.e., the Hot-Lime wash, the Caustic Soda wash and the Lime-Sulphur wash, the idea was literally to drench the fruit trees in winter with these sprays, in order to smother the eggs of various insects, and thus destroy them. However, it was soon realised that the egg-killing properties of these washes were not good, and as a result, these washes, more especially the Hot-Lime wash, and the Lime-Sulphur wash, were recommended as delayed dormant washes, and not as winter washes. The idea of the later application being to spray the trees at the period when the buds were developing and the insects were hatching from their eggs. In practice the delayed dormant application literally smothered the hatching insects, providing sufficient wash was used, and thus destroyed them.

More recently genuine egg-killing washes have been manufactured. They are known as the tar-distillate washes, and must be applied in winter (not in the delayed dormant season) for the destruction of insect eggs.

The objects of washing fruit trees in winter may be summarised thus :—

First, to clean the trees of moss, lichen, algae and rough bark, and thus remove the hibernating quarters of certain pests ; second, to destroy certain insects *in situ ;* and third, to destroy the eggs of certain insects, thus preventing attacks the following spring and summer.

The first of these aims has been readily achieved in the past. For instance, Caustic Soda and Hot-lime washes applied to the trees in winter, are known to destroy moss, lichen, algae, and other growths on the tree. For general cleaning purposes these washes have been used on a large scale. The Caustic Soda treatment is rather drastic since it sometimes causes the splitting of the bark, and therefore should be used once only every two or three years. In exceptional cases, where the trees are old, or in a neglected condition a yearly application may be necessary for a few seasons.

The removal of loose bark and hibernating quarters of insects, is also accomplished by the application of a Caustic Soda wash. A number of insects, such as, the Codlin Moth ; the Apple Blossom Weevil, and some Scales which normally hibernate on the trees are also destroyed, and the second object is thus attained.

The third object, that of destroying the eggs of insects, i.e., apple aphids, winter moth, sucker and other caterpillars has not been easy of attainment in the past.

It was stated, and not without a certain amount of justification, that if it were possible to smother insect eggs by coating them with a thorough dressing of Hot-lime, or to seal them up with a Caustic Soda wash, the hatching of the eggs would be prevented.

In practice this has not proved to be the case. Many species of insects are not affected by these washes. Take for instance, the Hot-lime wash, if it were possible to plaster the trees with this wash, doubtless much good would be done, but in practice the grower finds it impossible to apply sufficient lime to the trees to smother all the eggs, and those eggs which are not reached hatch out in the normal way. Again it has been proved that all insects are not destroyed, even when coated with the hot-lime wash. The Apple Blossom Weevil provides a very good example. An apple plot at East Malling was sprayed with a lime wash. The lime was put on at the rate of 112 lbs. quicklime to 100 gallons of water. Later many Apple Blossom Weevils were actually observed laying their eggs in the blossoms. The wing cases of these weevils, were tightly sealed, and their legs showed balls of lime on the joints. These weevils thoroughly coated in lime, were very active and able to continue their normal life-cycle three or four weeks after they had received the dressing. In fact lime-coated weevils were seen three months after the application of the lime.

However, a new series of washes known as the tar oils have been introduced which proved to be directly toxic to the eggs of many insects, thus inaugurating something of a revolution in winter spraying by supplying a long felt want.

At the same time it must be emphasised that the Caustic Soda wash and the Lime-sulphur spray have not been entirely superseded by the introduction of tar-distillate washes. Each of these washes may serve a useful and definite purpose, and when handled judiciously against the correct pest, may be used with great advantage as a winter wash. Sometimes, for one reason or another an alternative to a tar-oil must be used.

Before referring to these more recent sprays it is therefore proposed to say a word upon the special uses of Caustic Soda, Hot-lime and Lime-sulphur washes.

(1) Caustic Soda Wash.

The Caustic Soda wash has been used extensively and successfully in this country for cleansing fruit trees of moss, lichen, rough bark and algae. It is very effective against Mussel Scale and remains almost the only specific against Brown Rot. Caustic Soda must be used only on dormant trees.

A Caustic Soda spray is very easy to mix up. Five pounds of Caustic Soda

is dissolved in warm water. This stock solution is made up to twenty gallons of water, and the wash is ready for use.

It is an unpleasant wash to use since the Caustic Soda burns the hands and clothes of the operators. As a precaution against burning, the operators are advised to smear their hands with vaseline before spraying operations commence.

(2) Hot-Lime Wash.

This wash has been used very extensively, and is still favoured by some growers at the present time. It is recommended for checking many pests including the apple and plum Aphides, some species of weevil and the newly hatched larvæ of the Winter Moth. To be most effective this wash must be applied as a delayed dormant wash rather than as a Winter Wash.

Formula :—

Best White Lime	1 cwt.
Water	100 gallons.

Preparation :—

The lime is slaked, and, while still hot, water is added until the lime is sufficiently liquid to pass through a coarse sieve or sacking bag. The wash should be applied within forty-eight hours of mixing. Agitate wash in spray tank and apply by means of a power sprayer. Very little good can be obtained by means of a hand sprayer. Best results are obtained when the whole of the trees is thoroughly coated with lime.

The practice of whitening tree trunks with lime wash, applied by means of a brush, is still followed in many parts of the country, but apart from making the trees look nice, very little else is attained.

Hot-lime is just as unpleasant to use as Caustic Soda, therefore the operators must take precautions by wearing gloves, and smearing their hands and faces with vaseline. The clothes of the workers are also affected by the lime. This spray should not be used on a large scale unless growers are prepared to insist on the use of vaseline *ad lib.*

(3) Lime-Sulphur Spray.

This wash is applied as an insecticide to destroy the apple and plum Scale insects. Insects hiding under loose bark on the trees are also destroyed. This wash lacks to some extent the cleansing properties of Caustic Soda or Hot-lime.

Its use as a control for Apple Scab and other fungi has been practically discontinued as a true winter wash, its application being delayed until the delayed dormant or pink stage of the blossom.

Lime-sulphur is also recommended for application at winter strength for the eradication of the Black Currant Gall Mite, particulars of which will be found elsewhere.*

Lime-sulphur concentrate is best obtained ready made from the manufacturers.

Tar-Distillate Washes.

The Tar-distillate dormant winter washes must not be confused with the hot-lime and lime-sulphur washes which are now essentially delayed dormant washes.

The Tar-distillates have become very popular within the last six years and are now known to the majority of fruit growers in this country. These washes were first imported on a large scale from Holland some six years ago. At that time they were being used extensively on parts of the continent, and in some countries had come to be regarded as a standard winter wash for insect control, and in many parts of Holland tar-distillate washes were being applied to the same orchards each year, as a matter of routine, along with the other work of the farm.

A number of English insecticide firms began manufacturing their own brands of tar-oil, and some of these washes were appearing on the market about 1921 and 1922.

At that time, however, very little information was available regarding the tar-distillate washes in this country, and, as a result, many prominent fruit growers would not use these sprays extensively until they understood more about their egg-killing powers, and, more especially their effect upon the tree, and upon different varieties of fruit. This naturally led to a demand for experimental work in connection with the use and value of tar-distillates, and their effect upon the tree, when applied as dormant winter washes.

Now before these washes could be tested accurately it was essential to evolve a method of technique by which the comparative toxicity of the sprays, upon insect eggs, could be judged both in the laboratory and in the field.

A number of detailed experiments were therefore carried out at East Malling in relation to the toxicity of tar-distillates to insect eggs. These trials together, with the methods of technique employed will now be briefly referred to.

A number of trees were selected which harboured a considerable population of insect eggs. Individual shoots of these trees were chosen and labelled, and the number of eggs upon these shoots was recorded. When this operation was completed, the trees were sprayed with the tar-distillates included in the trials. The eggs upon the shoots, including those upon the unsprayed ("control")

* The Control of the Black Currant Gall Mite (A. M. Massee). Annual Report, 1926.

trees were examined from time to time, in order that the hatching period of the eggs could be observed in the field. When all eggs were considered to have hatched, a second survey of the shoots was undertaken. For this second inventory a large number of the shoots were removed from the trees and were examined individually in the laboratory, with the aid of a binocular microscope. A record of the number of hatched eggs on both sprayed and unsprayed ("controls") shoots was thus obtained. By adopting this method it was possible to ascertain the number of eggs which had been killed by the spray fluids.

In seasons when eggs were plentiful this procedure was found to be quite satisfactory, but in years when eggs were scarce it has been necessary to breed large numbers of insects, to ensure sufficient eggs for the continuation of the trials the following winter.

The results of these experiments have been very encouraging. They show that tar-distillate washes have a toxic effect upon certain insect eggs, the degree of toxicity varying according to the species of insect tested. As for example, the following table shows the toxicity of various tar-distillate washes to the eggs of the Hop-Damson Aphis (the leaf curling aphis of plum) in the laboratory.

TABLE I.

Toxicity of tar-distillate washes to the eggs of the Hop-Damson Aphis, in the Laboratory.

Treatment.	Number of Eggs.		Hatched	% Hatched of Apparently Sound.	% Reduction.	% Viable Eggs Killed.
	Apparently Sound.	Naturally Shrivelled.				
Unsprayed "Controls" ..	884	450	663	75	—	—
Standard A. ..	526	241	172	33	42	56
Standard B. ..	487	298	82	17	58	77
Carbokrimp ..	483	238	114	24	51	68
Mortegg.	431	179	97	23	52	69

It will be seen from the above table that the eggs which hatched on the sprayed shoots, in this laboratory test, varied from 17 per cent. to 33 per cent. The viable eggs killed varied from 56 per cent. to 77 per cent.

It is curious that only a certain percentage of the viable eggs should be killed and this fact cannot be accounted for. It is known that each egg was thoroughly wetted by the wash.

Experiments with the eggs of the winter Moth were also carried out, on a small scale, in the field.

The results obtained are shown in Table II.

TABLE II.

Toxicity of a tar-distillate wash to the eggs of the Winter Moth, in the field.

Treatment.	Eggs Labelled.	Hatched.		Reduction.	Viable Eggs Killed.
Unsprayed " Controls "	140	133	95%	—	—
Standard " A." ..	161	24	15%	80%	84%

Referring to the table, it will be seen that the percentage hatch on unsprayed (" controls ") is 95 ; and although the hatch on sprayed trees is as high as 15 per cent. the percentage of viable eggs killed is 84.

The spray used for this trial was a tar-distillate of known composition referred to as " Standard A." At the time it was not known that this spray was inferior to some others used in the tests. Had " Standard B " been used, the percentage of viable eggs killed would probably have been greater. Spray injury was not observed on any of the trees.

In addition to the particular trials referred to above, a further number of detailed experiments have been undertaken on similar lines. For the purposes of this paper, however, it is not considered necessary to refer to these in full.

It has been proved that tar-distillates applied at a strength of from 5 to 6 per cent. are toxic to many species of insect eggs. The most important of these being the eggs of the Rosy Apple Aphis, the Green Apple Aphis, the Plum and Currant Aphides, the Rose Greenfly, and in fact most species of aphides. Sucker eggs are destroyed also by tar-distillate applied at 5 per cent.

It has been found that the eggs of some caterpillar, i.e., Winter Moth, are more resistant, and, in order to destroy these ova, a 10 per cent. solution of tar-distillate must be used. The egg batches of the Vapourer Moth are more susceptible to tar-distillate than most caterpillar eggs. Vapourer eggs are destroyed by a $7\frac{1}{2}$ per cent. concentration.

Generally speaking it may be said that aphis can be controlled by applying a tar-distillate at 5 per cent. For caterpillar a 10 per cent. solution is surest. The grower will naturally find out extent of these egg batches before deciding on concentration. On the other hand, a number of insect and mite eggs are not affected by these sprays. The most notable of these being the eggs of the Fruit Tree Red Spider (*Oligonychus ulmi* C. L. Koch). The egg bands of the Lackey Moth remain unaffected by these washes. In one trial, a number of egg bands of this moth were submerged in a 10 per cent. solution of tar-distillate for more than twenty-four hours; three months later 90 per cent. of the eggs hatched and the young larvæ developed normally. The Black Currant Gall Mite which produces the so-called big-buds of black currant is not reached by a tar-distillate wash.

Tar-distillate washes have very good cleansing properties. All moss, lichen, loose bark, and algae are removed, giving the trees a healthy appearance.

Damage to Under Crops.

Unfortunately, tar-distillates damage root and vegetable crops, and therefore these sprays cannot be used on fruit trees under which such crops are grown. Where cover cropping is practised tar-distillates cannot be used, and the grower must resort to some kind of delayed dormant wash, such as a hot-lime wash.

Times of Application.

Times of application are very important. Tar-distillate washes must be used in the dormant season (November to March; according to season, and variety of tree in question), on apples, pears, plums, and most kinds of soft fruits, including raspberry, gooseberry and currants. Roses together with many varieties of herbaceous plants benefit considerably by an application of tar-distillate at the rate of 5 per cent.

Tar distillates must be applied to apples and currants from the beginning of November until the end of February. However, it is best to spray currants in December or in January if possible, since late applications in February frequently damage the developing leaves. The variety of Apple, Beauty of Bath, is very susceptible to spray injury, the buds being readily killed, and this apple should not be sprayed later than the middle of January.

Plums, cherries and pears are usually more advanced in coming into growth than apples and these fruits must be sprayed as early as possible. December and January are the ideal months. Damage is likely to result if they are sprayed in February or as soon as any signs of activity of the buds is apparent.

Some soft fruits such as gooseberries and raspberries may be sprayed with best advantage during January and February.

Special caution must be taken when spraying nuts. It is important to spray them before the female flowers open, otherwise damage is sure to result. December is the best month in which to wash cob nuts.

Storage.

The storage of tar-distillates must not be neglected. The drums or barrels should be put in a frost proof shed on arrival, or as an alternative may be covered up with straw or litter, where they will remain safe until required for use. Some brands of tar-distillate are inferior once they have been frozen.

Mixing Sprays.

To obtain satisfactory results the spray must be mixed correctly. It is best to measure off the exact quantity of tar-distillate concentrate and thoroughly

mix it with a similar quantity of water. This solution is then added to the required volume of water in the spray tank. Agitate well before using.

Where tar-distillate is applied by means of a power sprayer it is essential to wash out the pipes directly after use in order to prevent the wash clogging up the steel piping.

Effect Upon the Tree.

The tar-distillate washes spread very well on the trees, and it is thus possible to wet the whole surface when the sprays are applied properly. The spray goes on in the form of a thin whitish film. The colour varies according to the brand of spray used. This film gradually wears off as the spray dries on the trees.

It is a great advantage to be able to see the spray go on the tree because it enables the operator to be sure that the whole of the tree is wetted by the spray.

The tar-distillate washes possess a number of advantages when compared with some other so-called winter sprays. For example, they must be put on the trees in the dormant season when time and labour are available. They eliminate a good deal of spring and summer spraying; and, finally, they are readily obtained, easily mixed and are pleasant to use.

Other Egg-Killing Washes.

Other egg-killing washes, the Dinitro-o-cresol and its salts are now being used as winter washes for insect control. A series of trials have been in progress testing the toxicity of 3.5 Dinitro-o-cresol and sodium dinitro-o-cresylate to insect eggs.

The tests were carried out on a number of plum trees sprayed with fluids containing 3.5 dinitro-o-cresol, at concentrations ranging from 0.5 per cent. to 0.15 per cent. These tests show that from 80 to 82 per cent. of the viable eggs of the Hop-Damson Aphis were killed. Sodium dinitro-o-cresylate, also killed 80 per cent. of the viable eggs.

It is of interest to note these washes are toxic upon the same range of insect eggs as that of the tar-distillate washes. The eggs of Red Spider are not killed by dinitro-o-cresylate sprays.

Before deciding upon a particular form and concentration of winter wash, it is desirable to go into the orchard or plantation and examine the trees for the presence of insect eggs. When the trees have been examined and certain pests are found in numbers, it is possible to select the right spray, and apply it to the trees, for the destruction of the insect in question.

Other considerations that must be taken into account are such points as, cover crops, root and vegetable crops, etc., growing under the trees.

Finally it is not wise to apply the same kind of wash year by year without having some really good reason for doing so. As already stated, it is necessary

to be able to recognise the serious stages of the pests on the trees, and then choose the best spray for destroying them.

SUMMARY.

(*a*) The uses of the older winter washes, Caustic Soda, Hot-lime, and Lime-Sulphur are discussed—and the development of the use of the two latter as delayed dormant sprays is emphasised.

(*b*) The use and effect of true egg-killing washes—the tar-distillates—in the *dormant* season is described and the following recommendations made.

1. To destroy Greenfly, Scale and Sucker eggs apply a tar-distillate wash at the rate of 5—7½ per cent.
2. For caterpillar apply a tar-distillate wash at the rate of 7½—10 per cent.
3. Pears, Plums, Cherries and Currants should be sprayed with a tar-distillate from November to January, inclusive.
4. Apply a tar-distillate in December or January to currants to destroy the leaf-curling currant greenfly.
5. Tar-distillate will not destroy the Black Currant Gall Mite, the eggs of the Fruit Tree Red Spider or the eggs of the Lackey Moth.

(*c*) Attention is drawn to the existence of other substances now known to possess egg-killing properties—i..e, Dinitro-o-cresol and its salts.

Part V

Hops.

Part V

HOPS.

A beginning was made with the extended programme of investigation adopted in January, 1926.

Clone races of most of the principal commercial varieties have been established from a hill, the botanical characters of which are being described. The economic importance of this work was well illustrated in the past season by the behaviour of the " rogue " hills in our garden of Tutshams obtained from a commercial source. Not only did they crop poorly, but they proved highly susceptible to Downy Mildew. The twelve most outstanding of Professor Salmon's *New Seedling Varieties*, tested at Malling during the first fourteen years, have now been worked up in sufficient quantity for a more strict cropping trial, for comparison with selected commercial varieties. The aim is to grow a bigger bulk of these varieties for brewing trials.

Further batches of new seedlings are undergoing their preliminary trials.

Owing to the ravages of Mosaic Disease, the *Manurial* Trials in the field have failed to yield any very striking or consistent results. The factor of the number of hills per plot, dictated by the spread of disease, appears to be a more potent influence upon average weight per hill than any of the selective manurial treatments. However, the problem which was put up for solution on at least two acres—namely the merit of different forms of organic manure and of phosphate—was one which might possibly have given negative results in any case. If our field experiments show anything, it is that provided equivalent amounts of Nitrogen are given, the form is immaterial. The same would be true of phosphates, only in this series " no phosphate " plots are included and have cropped as well as any of the treated plots.

A third acre has been devoted to different quantities and forms of potash, and here again there are no very clear indications after five dressings, though there are a few figures which do seem to suggest that the total lack of potash is slightly disadvantageous.

The manurial question is now being tackled from a much more intensive standpoint, starting with pot culture experiments which were in progress during the year.

The technique for developing various *Cultural Experiments* in pulling, cutting and training, was explored during the year with a view to laying out reliable field trials.

PUBLICATIONS DURING THE YEAR.

*Salmon, E. S., *Professor*, S.E. Agricultural College, Wye. The Tenth Report on the Trial of New Varieties of Hops, 1926. August, 1927.

* Report issued on data collected jointly upon Hops grown at East Malling.

Part VI

Weather Conditions During 1927.

Part VI

WEATHER CONDITIONS DURING 1927.

By H. C. CHAPELOW and H. M. TYDEMAN.

The past year will be long remembered by most people as an excessively wet and inclement period, almost entirely unrelieved by any prolonged interval of consistently fine weather. The fruit grower may possibly be more inclined to lay emphasis on the devastating frosts which during April caused widespread havoc among the fruit blossom and converted the promise of an abundant fruit crop into what in reality proved, with the exception of apples, to be harvests of considerably less than average. In either case the year will be memorable as having exhibited the reverse of ideal weather conditions. The abnormally high rainfall of the first and third quarters of the year, those of seed sowing and harvesting respectively, imposed serious difficulties on the arable farmer, while the serious frosts and heavy rains have conspired to hamper the operations of the fruit farmer.

The total rainfall for the year was 37.34 inches just 12 inches in excess of the twelve years normal here. It rained on 183 days, nearly forty more than usual. Of the twelve months only April, May, October and November had less than the average rainfall while the remaining months with the exception of January, a very average month in this respect, were considerably in excess. The following table shows the distribution of the rainfall over the four quarters of the year :—

Period.	Average of 12 years. Total rain in inches.	Average of 12 years. No. of days.	1927. Total rain in inches.	1927. No. of days.
Jan. 1st to Mar. 31st. ..	5.74	41	9.34	52
April 1st to June 30th. ..	5.27	32	6.15	34
July 1st to Sept. 30th. ..	6.34	35	13.29	48
Oct. 1st to Dec. 31st. ..	7.97	38	8.56	49

As may be seen by far the greater proportion of the excess rainfall fell during the third quarter that from July to September inclusive during which more than twice the average amount of rain fell.

With regard to sunshine, taking the year as a whole, conditions were fairly normal ; the sun shone for a total of 1,420 hours, a quite average quantity. Its distribution however was a little irregular. The aggregate duration for the three months March, April and May was greater by sixty hours than that for the three succeeding months June, July and August. This was largely due

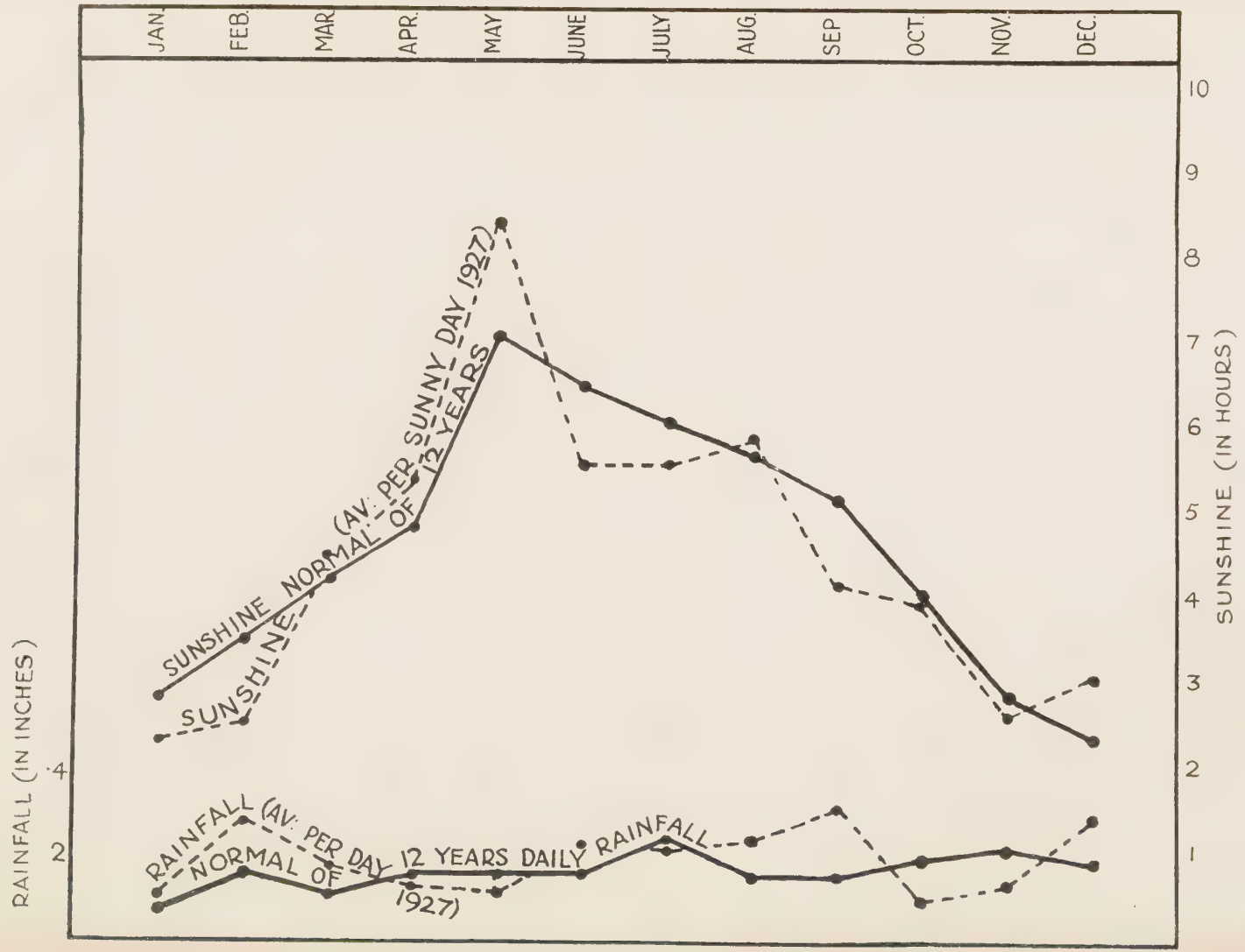
to the burst of sunny and dry weather experienced during late April and May and the dull wet weather to which it gave place.

Throughout the year ground frosts were recorded on ninety-one occasions, and their distribution through the months followed the usual sequence. Probably only those during April and May were at all noteworthy on account of the widespread damage to the fruit blossom, which they caused. Those which occurred on the nights of the 26th, 27th and 30th of April, 11, 7 and 8 degrees respectively, were the most destructive here and resulted in the loss of the greater part of the plum and pear crop, but among apples average crops of all varieties except Bramleys were obtained.

These frosts were quite severe for so late a period of the year but it is questionable whether they would have been so destructive to the fruit blossom had not they been succeeded in the early hours of the following mornings by extremely sunny weather conditions.

During the concluding days of December, extremely wintry conditions were experienced with the heaviest fall of snow of recent years in many districts.

Table showing SUNSHINE & RAINFALL during 1927 (Average per sunny or rainy day) compared with the previous 12 YEARS Average



	Barometer.	Temperature in Screen.					On Grass.		No. of Frosts.	Rainfall.				Sunshine.			Hydrometer.			Wind.
	Mean Reading.	Mean maximum.	Mean minimum.	Highest.	Lowest.	Mean.	Mean.	Lowest.		Total (ins.)	No. of days.	Av. per rainy day.	Heaviest fall in any one day.	Total hours.	No. of days.	Av. per sunny day.	Mean of dry bulb.	Av. deprec. of wet bulb.	Av. humidity.	Direction.
January ..	29.885	45.5	34.8	53	25	40.1	31.4	19.0	15	2.25	21	0.11	0.46	57.5	24	2.4	38.8	1.3	88	S.W. & S.S.W.
February ..	30.008	45.1	34.0	55	25	39.5	32.2	21.0	13	3.98	14	0.28	1.32	46.9	18	2.6	38.9	1.2	89	S.W. & W.S.W.
March ..	29.672	51.5	39.4	63	28	45.4	35.3	24.0	6	3.11	17	0.18	0.80	121.5	27	4.5	45.6	2.7	80	S.S.W. &. W.S.W.
April ..	29.865	55.7	39.7	71	30	47.7	35.8	19.0	5	1.58	12	0.13	0.37	157.5	29	5.4	48.6	4.2	70	N.W.
May ..	29.981	62.5	42.4	74	27	52.4	38.8	22.0	7	0.84	6	0.12	0.19	254.2	30	8.5	56.1	5.5	66	N.E. & W.N.W.
June ..	30.166	64.7	47.2	80	38	55.9	43.1	30.0	1	3.73	16	0.23	0.73	168.4	30	5.6	57.7	4.8	72	N.W.
July ..	29.822	67.3	53.4	78	44	60.3	49.7	39.0	0	3.96	18	0.22	1.34	140.7	25	5.6	62.4	3.7	80	N.N.E. & S.S.W.
August ..	29.980	68.6	53.4	76	44	61.0	49.6	40.0	0	4.57	19	0.24	0.60	173.9	29	5.9	62.2	3.3	82	W.S.W.
September ..	29.721	63.1	48.6	74	32	55.8	43.9	29.0	4	4.76	15	0.32	1.59	112.8	27	4.2	57.0	2.9	83	W. &W.S.W.
October ..	29.958	57.9	42.9	63	30	50.4	35.7	26.0	12	1.43	14	0.10	0.45	96.6	24	4.0	51.1	1.5	88	W.S.W.
November ..	29.950	48.1	36.9	63	26	42.5	32.2	21.0	13	2.45	19	0.13	0.73	49.6	18	2.7	42.3	1.3	89	W.S.W.
December ..	29.782	39.8	31.5	54	12	35.6	28.1	1.0	15	4.68	16	0.29	1.16	40.9	13	3.1	35.9	1.0	90	S.E.& E.S.E.

RULES OF ASSOCIATE MEMBERSHIP OF THE KENT INCORPORATED SOCIETY FOR PROMOTING EXPERIMENTS IN HORTICULTURE.

EAST MALLING RESEARCH STATION, KENT.

There are three Groups of Associate Members :—

Group A.—(Associate Members) "Founders."

Membership of this group is obtained by :—

A Single donation of £25 for Life Founders.

An annual subscription of £10 10s. for Annual Founder Members.

Founder Members are entitled :—

i. To receive the Annual Report of the Society, together with the supplement of special articles, free.

ii. To receive all other reprints and bulletins free.

iii. (*a*) To share (proportionately) in any distributions of selected material, at prices fixed by the Committee, and to be notified of such distributions and prices.

(*b*) To have priority in the matter of sharing in any distributions of novelties (if any) raised by the Station.

iv. To have advisory letters answered without a fee being charged.

v. (*a*) To receive special consideration in the matter of advisory visits, the identification of bushes, stocks, canes, etc.

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vi. To be notified of and eligible to attend all meetings of Associate Members, of which there shall be at least one annually for Founder and Fellow Associate Members.

vii. To be notified of and eligible to attend all General Meetings of the Society.

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Fellows are entitled to :—

i. Similar to Group A.

ii. To receive on application all other reprints and bulletins at cost price.

iii. (*a*) Similar to Group A.

iv. Similar to Group A.

v. (*a*) Similar to Group A.

vi. Similar to Group A.

vii. Similar to Group A.

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ii. To receive on application the Supplement of special articles, and any other reprints and bulletins at cost price.

iii. (*a*) Similar to Group B.

iv. Similar to Groups A. and B.

vi. To be notified of and eligible to attend all Associates days, of which it is hoped to have at least one annually.

vii. Similar to Groups A. and B.

Societies, Associations, Clubs, etc., donating or subscribing similar sums corporately will be admitted to Associate Membership on similar terms. They will be eligible for proportionate privileges for their Members and to send representatives to the General Meetings. Such Associations will also have a prior claim upon the services of any Member of Staff prepared to give Lectures.

All Annual Subscriptions will be payable before the end of March in each year. If the subscription is three months over due no further reports or notifications will be sent and membership will lapse.

Life Membership donations may be sent at any time.

In filling up the application form for Membership (at the end of the Report) each prospective member is invited to state the privileges he wishes to exercise.

LIST OF ASSOCIATE MEMBERS ENROLLED DURING 1927.

* Denotes Annual Membership as distinct from Life Membership.

GROUP A.—"FOUNDERS."

Lloyd George, David, The Right Hon. .. Churt, Surrey.

Phillpotts, G. S. .. Oakfield, Foxrock, Dublin, Ireland.

GROUP B.—"FELLOWS."

*Buggé, E. R. .. Eclipse Works, Westcombe Hill, S.E.3.

Daw, F. B. .. Woodmanton, Highcliffe, Hants.

*Green, L. H., Capt. .. The Whittern, Lyonshall, Kington, Herefordshire.

*Linden, H. Van Der .. Carbo-Krimp Co., Ltd., St. Mary's Chambers, 161A, Strand, W.C.2.

*Poix, R. de .. 23, Phillimore Gardens, Kensington, S.W.8.

Purcell, E. .. Chancellors Orchard, Kilkenny.

Whittall, W. J. H. .. Grayswood Hill, Haslemere, Surrey.

GROUP C.—ASSOCIATES."

*Addy, G. C. .. Feering Hill Farm, Kelvedon, Essex.

*Allen, G., Major .. Perrinwood, Headcorn, Kent.

*Amos, Mary, Miss .. Beyton Cottage, near Bury St. Edmunds, Suffolk.

*Bailey, A. .. Thorpe Wood, Thorpe, Selby, Yorks.

*Bennett, S., Major .. Oakenwood, Wateringbury, Kent.

*Blakeman, A. J. .. The Schools, Bowdon, Cheshire.

*Bull, Ivor .. Dalgmross, Cobham, Kent.

*Carter, Denis C. .. Hill House Farm, Boxted, Essex.

*Chambers, P. .. Shepway Court, Maidstone, Kent.

*Clayton, Collins .. 26, Market Place, Wisbech, Cambs.

*Crawford, W. .. Oakleigh, Higham, Strood, Kent.

Crompton, T. E. .. Week Green Nurseries, near Petersfield, Hants.

*Cubitt, E. G. .. Honing Fruit Farms and Nurseries, Honing, Worstead, Norwich.

*Dahl, C. G.	..	Alnarps Tradgardar, Alnarp, Akarp, Sweden.
*Davies, W. A., Rev.	..	Bettisfield Vicarage, Whitchurch, Salop.
*Davison, G. D.	..	Westwick Fruit Farm, Westwick, Norwich.
*Densham, S. C.	..	Little Hickmotts, Marden, Kent.
*Dering, A.	..	Woodwater, Heavitree, Exeter, Devon.
*Dixon, T. & M.	..	Tardebigge, Bromsgrove, Worcestershire.
*Edmeades, Major	..	Nursted Court, Meopham, Gravesend, Kent.
*Fillmer, S., Miss	..	Horticultural College, Swanley, Kent.
*Findley, Bros.	..	Springhill Nurseries, Baillieston, Glasgow.
*Gautrey, H. J.	..	Pelham House, Cottenham, Cambs.
Hayman, Dr.	..	Thorncliffe, Queen's Park, Bournemouth.
*Head, W.	..	Ecclesbourne, 29, Hartington Road, Chiswick, London, W.4.
*Heyst, B. G., Van	..	Wyk By Duurstede, Holland.
*Hopwood, W. & Son	..	58, High Street, Cheltenham, Gloucester.
*Hubsch-Schmitz, Otto	..	Merten, Kreis Bonn, Germany.
*Hynard, F. C.	..	Lower Austin Lodge, Eynsford, Kent.
*Keeble, F.	..	Brantham Hall, Manningtree, Essex.
*Kingsley Fruit Farm and Nursery	..	Kingsley, Bordon, Hants.
*Kirkhope, W. G.	..	Felmere, Felbridge, East Grinstead, Sussex.
Lupton, G. H.	..	Elgin, C.P., South Africa.
*Marshall, N. V.	..	The West Barnham Fruit Farm, Barnham, Sussex.
*Miles, W. & Co., Ltd.	..	16, Church Road, Hove, Sussex.
*Monins, J. E.	..	Ringwould, Kent.
*Norbury, F. P.	..	Sherridge, near Malvern, Worcester.
*Norbury, B.	..	Stratford-on-Avon, Warwick.
*Padwick, H.	..	The Red House, West Ashling, Chichester.
Penny, A., Raymond	..	7, The Avenue, Tiverton, Devon.
*Prichard, C. S., Col.	..	Princes Risborough, Bucks.
*Quayle, J. B.	..	Valley Farm Bungalow, Brantham, Manningtree, Essex.

*Roberts, A. E.	..	The Nurseries, Swanwick, Hants.
*Roger, R. V.	..	The Nurseries, Pickering, York.
*Rowntree, B. S.	..	The Homestead, York.
*Sale & Son	..	Nurserymen, Wokingham, Berks.
*Scrutton, M. E., Miss	..	Bottrell's Cottage, Chalfont St. Giles, Bucks.
*Sevenoaks N.F.U.	..	Homefield, Sevenoaks, Kent.
*Smith, F.	..	Fant Farm, East Peckham, Kent.
*Smith, G.	..	Goose Green Farm, Hadlow, Tonbridge.
*Starkey, J. R.	..	Norwood Park, Southwell, Notts.
*Stokes, J. M.	..	Grower and Merchant, Evesham, Worcester.
*Storrie, D. L.	..	15, American Muir Road, Dundee.
*Strouts, E. W.	..	Bishopsdale Farm, Biddenden, Kent.
*Tayler, W. (the late)	..	Peace, Ashted Lane, Godalming, Surrey.
*Todd, M. A.	..	Worcestershire Club, Worcester.
*Turner, E.	..	Ministry of Agriculture, Wellington Place, Belfast.
*Voss & Co., Ltd.	..	Carlton Works, Millwall, E.14.
*Voysey, C. J.	..	Highdown Nurseries, Ferring, Sussex.
Warnock, J.	..	Garrion Farm, Wishaw.
*Watson & Wetterstrand	..	Sunninglye, Pembury, Kent.
*Wesseling & Co.	..	The Nurseries, Naarden, Holland.
*Western, F.	..	Scraces, Barming, Kent.
*Weston, H. B.	..	The Rocks, East Malling, Kent.
*Wigan, W. L.	..	Clare Cottage, East Malling, Kent.
*Witherby, Geo.	..	23, De Vere Gardens, London, W.8.
*Wood, T. H. & Sons	..	Fruit Growers, The Mount Offices, Farningham, Kent.
*Worts, C., Dr.	..	Penlan Hall, Fordham, Colchester.
*Youatt, L., Dr.	..	6, Aspinale Street, Prescot, Lancs.
*Youatt, N., Miss	..	Applegold, Little Leighs, Chelmsford, Essex.